

THE DYNAMIC OF KNOWLEDGE PRODUCTION AND UTILISATION

TRACY BAILEY

*crest*

Centre for Research on
Science and Technology





**THE PRODUCTION AND UTILISATION OF KNOWLEDGE IN HIGHER
EDUCATION INSTITUTIONS IN SOUTH AFRICA**

Volume 4

**The dynamic of knowledge production and
utilisation: Fifteen case studies**

Tracey Bailey (Editor)

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The Production and Utilisation of Knowledge in Higher Education Institutions in South Africa
(Volume 4): The Dynamic of Knowledge Production and Utilisation: Fifteen Case Studies

Published by SUN PRess, a division of AFRICAN SUN MeDIA, Stellenbosch 7600

www.africansunmedia.co.za

www.sun-e-shop.co.za

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First edition 2005

ISBN: 978-1-919980-64-5

e-ISBN: 978-1-919980-72-0

DOI: 10.18820/9781919980720

Set in 11/13 Lucida Sans Unicode

Cover design by Dewald van Zyl

Typesetting by Marthie van Niekerk

SUN PRess is a division of AFRICAN SUN MeDIA, Stellenbosch University's publishing division.
SUN PRess publishes academic, professional and reference works in print and electronic
format. This publication may be ordered directly from <http://www.sun-e-shop.co.za>

CONTENTS

Preface	i
Introduction	1
Case study 1: Lactic acid bacteria research <i>Nelius Boshoff</i>	15
Case study 2: The genetic improvement and utilisation of indigenous Tilapia (<i>oreochromis mossambicus</i>) in Southern Africa <i>Gerrit Loots</i>	89
Case study 3: Sequence Tag Alignment and Consensus Knowledgebase (STACK) <i>Nelius Boshoff</i>	149
Case study 4: Friction stir welding <i>Leisl Bowers</i>	173
Case study 5: Running a collaborative research project as a shareholding company <i>Nelius Boshoff</i>	203
Case study 6: Capillary ultrafiltration membrane technology and process development <i>Tracy Bailey</i>	245
Case study 7: Towards the development of an appropriate extension model approach for South Africa <i>Gerrit Loots</i>	311
Case study 8: The domestication of indigenous vegetables <i>Gerrit Loots</i>	365
Case study 9: The Langebaan Community-based Growth Monitoring Model <i>Maryke Hunter-Hüsselmann</i>	397
Case study 10: Rural (SEED) Sustainable Energy, Environment and Development) project (Phase I) <i>Tracy Bailey</i>	428

Case study 11: Electricity Basic Services Support Tariff (EBSST) project <i>Tembile Kulati</i>	480
Case study 12: The KwaZulu-Natal Income Dynamics Study (KIDS) <i>Tracy Bailey</i>	494
Case study 13: The Centre for the Study of Higher Education (CSHE) <i>Tembile Kulati</i>	554
Case study 14: Children's understanding of fractions <i>Jaamiah Galant</i>	589
Case study 15: The Co-ordinated Avifaunal Roadcounts (CAR) project <i>Tracy Bailey</i>	630

PREFACE

In June 2002, the Carnegie Corporation of New York awarded a substantial grant to CREST – then the Centre for Interdisciplinary Studies – to conduct research on the production and utilisation of research in higher education in South Africa.

In the original proposal to Carnegie, we described the context and rationale behind this project as follows:

With the advent of the new democracy in 1994, it was expected that the higher education institutions in the country would and should play a major role in the transformation of South African society. On the one hand, South African universities and technikons were expected to transform themselves; on the other hand, as major actors within the national system of innovation, it was also expected that they would make a significant contribution to the new society in various ways, including the production of relevant and useful knowledge.

The focus in the project is on the R&D function of higher education institutions; on the knowledge produced by scientists and scholars at these institutions. In terms of this focus, the overarching aim of the proposed project is to analyse and assess to what extent South African universities and technikons are engaged in a transformative agenda in the production and utilisation of scientific knowledge. Two major research questions will drive the project:

- ◀ To what extent has the production of scientific knowledge at SA universities and technikons changed over the past seven years?*
- ◀ To what extent is the knowledge produced at SA universities and technikons used, particularly in the interest of new national goals?*

At the same time as we commenced our work on this project, the National Advisory Council on Innovation placed on tender a national study on the state of research utilisation in South Africa. CREST was awarded a grant to conduct a survey of public sector R&D as well as a separate interview-based study of industry views on research utilisation. We subsequently integrated our work on the Carnegie project and the NACI commission into a two and a half year study. By the end of December 2004 we completed our research.

The findings of this study have been organized into six separate reports:

- Volume 1: A review of models of research utilisation
- Volume 2: A survey of research utilisation
- Volume 3: An industry study of the utilisation of public R&D
- Volume 4: The dynamic of knowledge production and utilisation: Fifteen case studies
- Volume 5: The role of intermediary organisations in the utilisation of research
- Volume 6: Knowledge for transformation: Modes of knowledge production and utilisation in post-apartheid South Africa

In this Volume, we present fifteen detailed case studies of research projects, research programmes or research units/centres, with a specific focus on the dynamics of the knowledge production and utilisation processes and contexts. The case studies seek to address the second objective of the broader project, namely:

To establish to what extent the knowledge produced at South African universities and technikons is used and utilised in the interest of national goals.

I would like to extend my thanks to Tracy Bailey for writing the introduction and to Marthie van Niekerk for her invaluable assistance completing this report.

Acknowledgements

Case study 1: Lactic acid bacteria research

Nelius Boshoff

I am grateful to Dr Maret du Toit for allowing me to use her three projects as objects of enquiry. I am also indebted to her project collaborators and people in the wine industry for being willing to be interviewed. Without their input the case study would not have been possible.

Case study 2: The genetic improvement and utilisation of indigenous Tilapia (*oreochromis mossambicus*) in Southern Africa

Gerrit Loots

This case study would not have been possible without the permission and co-operation from the programme manager, Dr Danie Brink. Inevitably, during a research process such as this, requests are made to the parties involved to make time available and be willing to respond positively to follow-up requests for additional information. To Dr Brink and his colleagues Dr Kriek Bekker and Mr Khalid Salie, I want to express my sincere appreciation for the time and positive co-operation that I've received in the course of drafting this case study. To Mr Jacques Stofberg of the Office for Intellectual property, I want similarly to thank you for your time and help. To my colleagues at CREST, I want to express my appreciation for your help and constructive inputs into the drafting process of the case study - I surely experienced the positive effect of team work in the drafting process.

Case study 3: Sequence Tag Alignment and Consensus Knowledgebase

Nelius Boshoff

This case study would have been impossible without the cooperation of Prof Win Hide (SANBI) and Ms Tania Broveak-Hide (Electric Genetics Corporation). I thank them for being willing to be interviewed, as well as for commenting on my making sense of their STACK project.

Case study 4: Friction stir welding

Leisl Bowers

I wish to extend my profound gratitude to the following people who contributed towards the completion of this case study report: My parents and sister for their support; Professor Johann Mouton for his supervision; the Manager of the Automotive Components Technology Station, the Director of the Unit for Research Development and the Dean of the Faculty of Engineering at Port Elizabeth Technikon for willingly and generously sharing their experiences with me; Dr Frank Teng-Zeng and Ms Tracy Bailey for assisting and guiding me in my work; Mrs Lucinda Lindsay and Ms Marthie van Niekerk for their ready assistance in the necessities; my friends and colleague Mr Gerrit Loots for encouraging me and lastly, Our Lord, Jesus Christ.

Case study 5: Running a collaborative research project as a shareholding company

Nelius Boshoff

I thank Prof Kit Vaughan, Mr Herman Potgieter and Dr Dan Jones for allowing me to interview them about their AMI activities. I also thank Prof Vaughan and Mr Potgieter for patiently reading through and commenting to the draft case study report.

Case study 6: Capillary ultrafiltration membrane technology and process development

Tracy Bailey

The development of this case study has depended to a very large extent on interaction with Dr Ed Jacobs and Dr Lingam Pillay. I would like to thank both Dr Jacobs and Dr Pillay for being so willing to give of their time and energy, and for engaging so deeply with the needs of the case study. I would also like to thank my colleagues at CREST for their very useful comments and suggestions on the first draft of this report, and Ed and Lingam for taking time to scrutinise and provide feedback on the final draft.

Case study 7: Towards the development of an appropriate extension model approach

Gerrit Loots

I want to express my appreciation to Professor Gustav Düvel from the South African Institute of Agricultural Extension who, in spite of his very busy programme, has given permission for this case study research and was willing to be interviewed. All material that was subsequently requested, as well as email requests for follow-up clarification, was dealt with in a prompt manner. Furthermore, I want to thank Mr Ben Saaiman from the Western Cape Department of Agriculture, who, as one of the provinces involved in the utilisation of the research, added his valuable contribution on the participatory process that they were involved in. To my colleagues at CREST, I want to express my appreciation for your help and constructive inputs into the first draft of the case study.

Case study 8: The domestication of indigenous vegetables

Gerrit Loots

I want to express my appreciation to Dr Patrick Masika and his staff from the Agricultural and Rural Development Research Institute who received me at Fort Hare in a very friendly and helpful manner during two days in July 2003. I was given all the necessary help and their time to do interviews with Dr Masika as well as ten small-scale farmers in three villages. I also want to thank Ms Phatheka Peter, the project leader, who accompanied me to the villages Guquka, Lower Gqumahashe and Roxeni and assisted me to communicate with the small farmers. To my colleagues at CREST, I want to express my appreciation for your help and constructive inputs into the first draft of the case study.

Case study 9: The Langebaan Community-based Growth-Monitoring Model

Maryke Hunter-Hüsselmann

I would hereby wish to thank Ms Serina Schoeman, the project leader of the Langebaan project, for her willingness to participate in this study and for providing me with necessary documentation and information on this project. I would also like to thank the women of Langebaan who participated in the focus group interview. They made a definite impression on me and I wish them success in trying to continue their work on growth-monitoring and deworming in the community.

Case study 10: Rural Sustainable Energy, Environment and Development (SEED) project (Phase I)

Tracy Bailey

I would like to thank Mr Bill Cowan (Energy Research Centre, University of Cape Town), Mr Boyce Platjies (Department of Minerals & Energy), and Mr René Karotki (Danish Technical Advisor), for their assistance in the development of this case study. My particular thanks goes to Mr Cowan who contributed much time and effort in the interview and in providing all the relevant project documents and contact details for some of the other participants in the project. I would also like to thank my colleagues at CREST for their very useful comments and suggestions on the first draft of this report.

Case study 11: Electricity Basic Services Support Tariff (EBSST) project

Tembile Kulati

I would like to express my thanks to Professor Trevor Gaunt (Research Leader, EBSST Research Project, and Professor, Department of Electrical Engineering, University of Cape Town) for his assistance in the development of this case study.

Case study 12: The KwaZulu-Natal Income Dynamics Study (KIDS)

Tracy Bailey

I would like to thank Associate Professor Julian May, Professor Michael Carter, Dr Lawrence Haddad, Mr Ben Roberts, Dr John Maluccio, Associate Professor Francis Lund and Professor Vishnu Padayachee for their assistance in the development of this case study. Each of these individuals have offered their time for interviews, providing all the relevant project documents and publications that I required, and in answering many questions via e-mail. I would also like to thank my colleagues for their very useful comments and suggestions on the first draft of this report.

Case study 13: The Centre for the Study of Higher Education (CSHE)

Tembile Kulati

I would like to thank Professor George Subotzky (Director, CSHE, University of the Western Cape) for his assistance in the development of this case study. I would also like to thank all the interviewees for the invaluable contribution they made to the case study.

Case study 14: Children's understanding of fractions

Jaamiah Galant

This case study could not have been done without the contributions from the Project Leader, Alwyn Olivier and Principal investigator, Dr Amanda le Roux. Thank you for giving up your time to be interviewed. Thanks also to you and your colleague, Hanlie Murray, for passing on relevant project documentation and giving feedback on an earlier draft. My thanks to the following BEd students who agreed to be interviewed and in so doing, added value to this case study report: Nicoleen Schoeman (3rd year) ; Samantha Marais (3rd year); Angela Rob (4th year); Petro Du Preez (4th year). Finally, thank you to my colleagues at CREST for their insightful and constructive comments on earlier drafts of the case study report.

Case study 15: The Co-ordinated Avifaunal Roadcounts (CAR) project

Tracy Bailey

I would like to thank Professor Les Underhill, Mrs Donella Young and Mr James Harrison of the Avian Demography Unit for their assistance in the development of this case study. My particular thanks goes to Mrs Young who contributed much time and effort in providing all the relevant project documents, photographs and the contact details for some of the users of the research, and in answering many questions via e-mail. I would also like to thank my colleagues at CREST for their very useful comments and suggestions on the first draft of this report, and Mr Harrison and Mrs Young for taking time to scrutinise and provide feedback on the final draft.

Tracey Bailey (EDITOR)

Stellenbosch

INTRODUCTION

This introductory section outlines the case study methodology employed, including the selection of the cases and the process followed by the research team in developing the case studies. We begin with a brief overview of the fifteen case studies included in this volume in order to provide the reader with a navigation tool for this report.

1 The case studies at a glance

Abstracts of the fifteen case studies are presented below in the order that they appear in this volume. In addition, selected features of each of the case studies, such as the scientific domain(s) or discipline(s) within which each research project, programme or unit is located, and the primary mode of utilisation, are included in the summaries.

All but two of the case studies focus on a project, programme or research centre/unit that is based in a university or a technikon. The two exceptions include cases based within the Agricultural Research Council and the Medical Research Council, since these emerged as interesting cases during the selection process.



Case study I Lactic acid bacteria research Case study by Nelius Boshoff

This case study focuses on the research uptake of three projects of Dr Maret du Toit, a senior researcher at the Institute for Wine Biotechnology, University of Stellenbosch. All three projects involved, to various extents, an investigation into lactic acid bacteria (LAB) and its role in fermentation and the quality of the end product. These projects were funded by the Wine Industry Network of Expertise and Technology (WINETECH). WINETECH is the overarching R&D funding structure in the South African wine industry, which links the research performers to the industry partners. The first project, which is still ongoing, is about the role of microorganisms in the formation of bitterness in wines. The second project has been completed and focuses on the occurrence of malolactic fermentation (MLF) in rebate wine and its influence on brandy quality. The third project investigated the sources of acetic and other fatty acids and their role in sluggish or stuck fermentations.

- Project leader: Dr Maret du Toit (Institute for Wine Biotechnology, University of Stellenbosch)
- Scientific domain: Wine microbiology
- Primary model of knowledge utilisation: An industry-based network as intermediary between knowledge producers and knowledge users



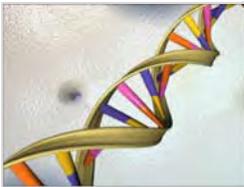
Case study 2

The genetic improvement and utilisation of indigenous *Tilapia (oreochromis mossambicus)* in Southern Africa

Case study by Gerrit Loots

This case study documents a decade-long process whereby an indigenous fish species (Tilapia) was genetically improved with the result of making it a viable commercial commodity for the South African aquaculture sector. The case study also documents the process from research via intellectual property issues to commercialisation, as well as developmental utilisation in the areas of food security and income enhancement. It also focuses on the continuous dynamic of multi-sectoral collaboration as a vital element for success in the area of research and development.

- Project leader: Dr Danie Brink (Department of Genetics, University of Stellenbosch)
- Scientific domain: Animal genetics
- Primary model of knowledge utilisation: Technology transfer for commercialisation and rural development



Case study 3

Sequence Tag Alignment and Consensus Knowledgebase

Case study by Nelius Boshoff

The South African National Bioinformatics Institute (SANBI) was established at the University of the Western Cape around an extensive database project called the Sequence Tag Alignment and Consensus Knowledgebase (STACK). Professor Win Hide, the director of SANBI, conceptualised the project. The project delivered two product technologies. The first is a database, called STACKdb, which contains a comprehensive representation of the sequence of each of the expressed genes in the human genome. The second product, stackPACK, is a set of clustering tools that was used to create the database. Through a grant from the Innovation Fund, SANBI collaborated with Electric Genetics, a spin-off company, in commercialising the STACK products. Ms Broveak-Hide heads Electric Genetics.

- Project leader: Professor Winston Hide (South African Bioinformatics Institute, University of the Western Cape)
- Scientific domain: Bioinformatics
- Primary model of knowledge utilisation: Commercialisation through spin-off company



Case study 4

Friction stir welding

Case study by Leisl Bowers

This case study focuses on the Friction Stir Welding (FSW) project undertaken by a research team in the Manufacturing Technology Research Centre (MTRC) at Port Elizabeth Technikon. The FSW project evaluated the influence of weld travel speed (the advancement in making the weld in millimetres per minute) on a specific grade of aluminium plate supplied under a particular heat treatment condition. A great influence on the choice of research project by the researcher and on the development of the MTRC, is the backdrop to the academic institution in which this project is set, i.e. the Eastern Cape region of South Africa, which has a highly integrated motor manufacturing industry. The very technical research process of the FSW process involved the conversion of a milling machine to a FSW machine to evaluate, measure and record the influencing variables during the welding of two aluminium plates.

- ◀ Project leader: Dr Danie Hattingh (Automotive Components Technology Station, Port Elizabeth Technikon)
- ◀ Scientific domain: Automotive engineering
- ◀ Primary model of knowledge utilisation: Technology and process development for commercialisation; limited utilisation at this point



Case study 5

Running a collaborative research project as a shareholding company

Case study by Nelius Boshoff

De Beers, the leading diamond industry in South Africa, developed an ultra-low dose X-ray system (called Lodox) with a specific application to trauma. Together with a group of researchers from the University of Cape Town, representing various disciplines, a research consortium was formed. The consortium included a research facility of the National Research Foundation. Under the leadership of Professor Kit Vaughan from the Department of Human Biology at UCT, a grant application was made to the Innovation Fund of the national Department of Science and Technology. Upon approval, the consortium organised itself into a commercial company known as African Medical Imaging Pty Ltd. De Beers, UCT and NRF were allocated company shares to prevent future disputes about the distribution of intellectual property ownership.

- ◀ Project leader: Professor Kit Vaughan (Department of Human Biology, University of Cape Town)
- ◀ Scientific domain: Medical imaging

- Primary model of knowledge utilisation: University-industry collaboration and patenting within the context of a shareholder company; no utilisation in commercial sense yet.



Case study 6

Capillary ultrafiltration membrane technology and process development

Case study by Tracy Bailey

The focus of this case study is on a series of research projects, funded primarily by the Water Research Commission), and undertaken in collaboration between researchers at the University of Stellenbosch and the Durban Institute of Technology. These projects have resulted in the development of a membrane technology for the treatment of drinking water. The original aim of early projects in the series was to develop a new membrane filtration process for treating water from non-saline sources for drinking purposes. Among the objectives was to find a way of avoiding the use of any chemicals upstream of the membrane filtration operation, and that chlorine would only be used in a limited way. In addition, the technology needed to be cost-effective and require low-maintenance, to suit local rural conditions. The series of projects that emerged over the ten-year period extended far beyond the original objectives laid out in the contract with the WRC, proceeding beyond the phases of research, and process and systems engineering, to industrialisation and even technology transfer for commercialisation.

- Project leaders: Dr Ed Jacobs (Institute for Polymer Science, University of Stellenbosch) & Dr Lingam Pillay (Department of Chemical Engineering, Durban Institute for Technology)
- Scientific domains: Polymer science, chemical engineering, biotechnology
- Primary model of knowledge utilisation: Research, development and technology transfer for industrialisation and commercialisation



Case study 7

Towards the development of an appropriate extension model approach for South Africa

Case study by Gerrit Loots

This case study focuses on a project that was the result of a tender allocated to the South African Institute for Agricultural Extension by the national Department of Agriculture. The project is viewed by stakeholders to be of strategic importance owing to the fundamental transformation that took place in agricultural extension, from a mainly commercial focus to a small farmer and developmental focus. The project timeline was 2001 – 2002 with the final executive report published on the 17 March 2003. A participatory (action) research methodology was chosen by the project leader as the methodology most likely to reach the goals of the project, namely participation and buy-in, as well as capacity building of

stakeholders (i.e. all extension personnel in the nine provincial Departments of Agriculture). The participatory methodology and input from extension personnel had the result that the original title of the project, wanting to develop a “model”, was changed into an “approach”, expressing the dynamic of the process and the importance of participation by all parties involved.

- ◀ Project leader: Professor Gustav Düvel (SA Institute for Agricultural Extension, University of Pretoria)
- ◀ Scientific domain: Agricultural extension
- ◀ Primary model of knowledge utilisation: Agricultural extension



Case study 8

The domestication of indigenous vegetables

Case study by Gerrit Loots

The project described in this case study, namely The domestication of indigenous vegetables, was the result of a grant from the International Centre for Underutilised Crops (ICUC) to the Agricultural and Rural Development Research Institute (ARDRI) at the University of Fort Hare. Both organisations share the goal of contributing to food security within rural communities. Agriculture (small-scale farming) is identified as a vital source of livelihood and is practiced by 1 594 people in the Nkonkobe municipality in the Eastern Cape province where the project was established. It therefore made good sense when ARDRI decided to apply the ICUC funding to work towards the re-establishment of traditional and indigenous vegetables, namely Amaranthus, Cucurbits and Plectharanthus, in the villages of Guquka, Lower Gqumahashe and Roxeni.

- ◀ Project leader: Ms Phatheka Peter (Agricultural and Rural Development Research Institute, University of Fort Hare)
- ◀ Scientific domain: Agricultural sciences
- ◀ Primary model of knowledge utilisation: Agricultural extension, community development



Case study 9

The Langebaan Community-Based Growth-Monitoring Model

Case study by Maryke Hunter-Hüsselmann

In 1994 the Nutritional Intervention Research Unit (NIRU), one of the research units of the Medical Research Council (MRC), was approached by the Child Welfare Society of South Africa to do an investigation on perceived problems of malnutrition in the West Coast area. After negotiations with all relevant role players, it was decided to implement a

community-based growth-monitoring model in Langebaan North. The negotiations, which started in 1994, were followed by a baseline survey conducted in October 1995. The model, which was implemented after the baseline survey and the ZOPP workshop, ran from August 1996 to March 1998 and had success in terms of determining the effectiveness of such a model in helping existing health facility services in a community.

- ◀ Project leader: Serina Schoeman (Nutritional Intervention Research Unit, Medical Research Council)
- ◀ Scientific domain: Nutritional science
- ◀ Primary model of knowledge utilisation: Participatory research for community development

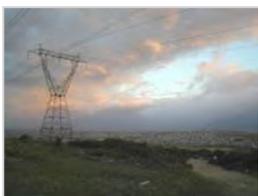


Case study 10
Rural Sustainable Energy, Environment and Development (SEED) project (Phase I)

Case study by Tracy Bailey

This case study documents a research project undertaken by the Energy Research Centre at the University of Cape Town, which seeks to address the social inequities in energy services among the rural poor. The Rural SEED (Sustainable Energy, Environment and Development) project (Phase I) was a multifaceted endeavour. It was both action research and pilot implementation, aimed at improving energy services for low-income rural communities, in support of sustainable rural development. The project was undertaken in collaboration with local communities, non-governmental organisations, energy suppliers and local and national governments. In addition, critical focal points of the project included capacity building among local and national government, energy suppliers and rural communities, and the facilitation of information flow between these stakeholders.

- ◀ Project leader: Mr Bill Cowan (Energy Research Centre, University of Cape Town)
- ◀ Scientific domain(s): Sociology, energy
- ◀ Primary model of knowledge utilisation: Community development, research for policy



Case study 11
Electricity Basic Services Support Tariff (EBSST) project

Case study by Tembile Kulati

The Electricity Basic Services Support Tariff (EBSST) project – or BEST (the Basic Electricity Support Tariff), as it later became known - was undertaken by a multi-

disciplinary research team that consisted primarily of researchers from the University of Cape Town, as well as independent consultants. The objective of the project, which was commissioned by ESKOM and funded by the Department of Minerals and Energy (DME), was to undertake research that would provide the basis for the DME to make decisions regarding the implementation of a poverty alleviation programme through the provision of a basic (electricity) services support tariff. Although there is now some dispute with regard to whether this was the case, the intention was that the research product, which would examine the technical, financial and social implications of the policy objective; would form the basis for a policy document that would spell out the modalities of rolling out the policy intent of government, namely the provision of free basic electricity to the poor.

- ◀ Project leader: Prof Trevor Gaunt (Department of Electrical Engineering, University of Cape Town)
- ◀ Scientific domain: Energy policy research
- ◀ Primary model of knowledge utilisation: Improving service delivery through (research-based) policy reform



Case study 12

The KwaZulu-Natal Income Dynamics Study (KIDS)

Case study by Tracy Bailey

This case study documents the initiation, progression and utilisation of the first longitudinal or panel study of poverty in South Africa, namely the KwaZulu-Natal Income Dynamics Study (KIDS). The KIDS project was undertaken in collaboration by researchers at the School of Development Studies (University of KwaZulu-Natal), the Department of Agricultural & Applied Economics (University of Wisconsin-Madison), and the International Food Policy Research Institute (IFPRI) in Washington DC. The KIDS project is an econometric analysis of persistent poverty, assets and income trends based on national survey data, a provincial panel study and qualitative research. KIDS 'second wave' involved the re-surveying in 1998 of a sample of households in KwaZulu-Natal that were surveyed in 1993 as part of another national poverty survey. Although not originally planned, during the course of the project a qualitative component was added which focused on a subset of the households in the sample. The KIDS 'third wave' is currently underway, in which the same sample of households are being resurveyed.

- ◀ Project leaders: Assoc Prof Julian May (University of KwaZulu-Natal); Prof Michael Carter, (University of Wisconsin-Madison); Dr Lawrence Haddad (International Food Policy Research Institute)
- ◀ Scientific domain(s): Economics, sociology
- ◀ Primary model of knowledge utilisation: Research for policy



Case study 13

The Centre for the Study of Higher Education (CSHE)

Case study by Tembile Kulati

This case study examines the history and dynamics of knowledge utilisation in higher education policymaking in (post-apartheid) South Africa, using the Centre for the Study of Higher Education at University of the Western Cape as a the focus of our analysis. The discussion unfolds against the backdrop of the process of higher education policy development, especially in the post-1994 period. One of the key issues that emerge in the analysis is the multifarious understanding of the way in which the research undertaken by the CSHE was going to be utilised. The study highlights three notions of utilisation that are a feature of the research of the CSHE, namely:

- ◆ Utilisation as generation of ideas, and particularly as a contribution to the debates on social reconstruction
- ◆ Utilisation as input into the policymaking process
- ◆ Utilisation as contribution to higher education scholarship

The case study documents how the CSHE has struggled over the years to balance these sometimes-conflicting understandings of research utilisation.

- ◀ Project leader: Prof George Subotzky (CSHE, University of the Western Cape)
- ◀ Scientific domain: Higher education
- ◀ Primary model of knowledge utilisation: Research for policy



Case study 14

Children's understanding of fractions

Case study by Jaamiah Galant

This case study documents the initiation, process, outcomes and utilisation of one of the research projects undertaken by a research team at the Research Unit for Mathematics Education at the University of Stellenbosch (RUMEUS). The project sought to gain a deeper understanding firstly, of how children, within a 'problem-centred' classroom context, argue and articulate their thoughts when working in groups and secondly, how these arguments reflect the way children learn mathematics. The mathematical context of the project is the teaching and learning of fractions. The research process entailed extended classroom observations and included materials development, interactions with learners and teachers, as well as classroom interventions by both researchers and teachers. The research has been used extensively by the researchers themselves on the teacher pre-service and in-service courses at Stellenbosch University.

- ◀ Project leader: Ms Amanda le Roux (Research Unit for Mathematics Education, University of Stellenbosch)

- ◀ Scientific domain: Mathematics education
- ◀ Primary model of knowledge utilisation: Action research to inform practice



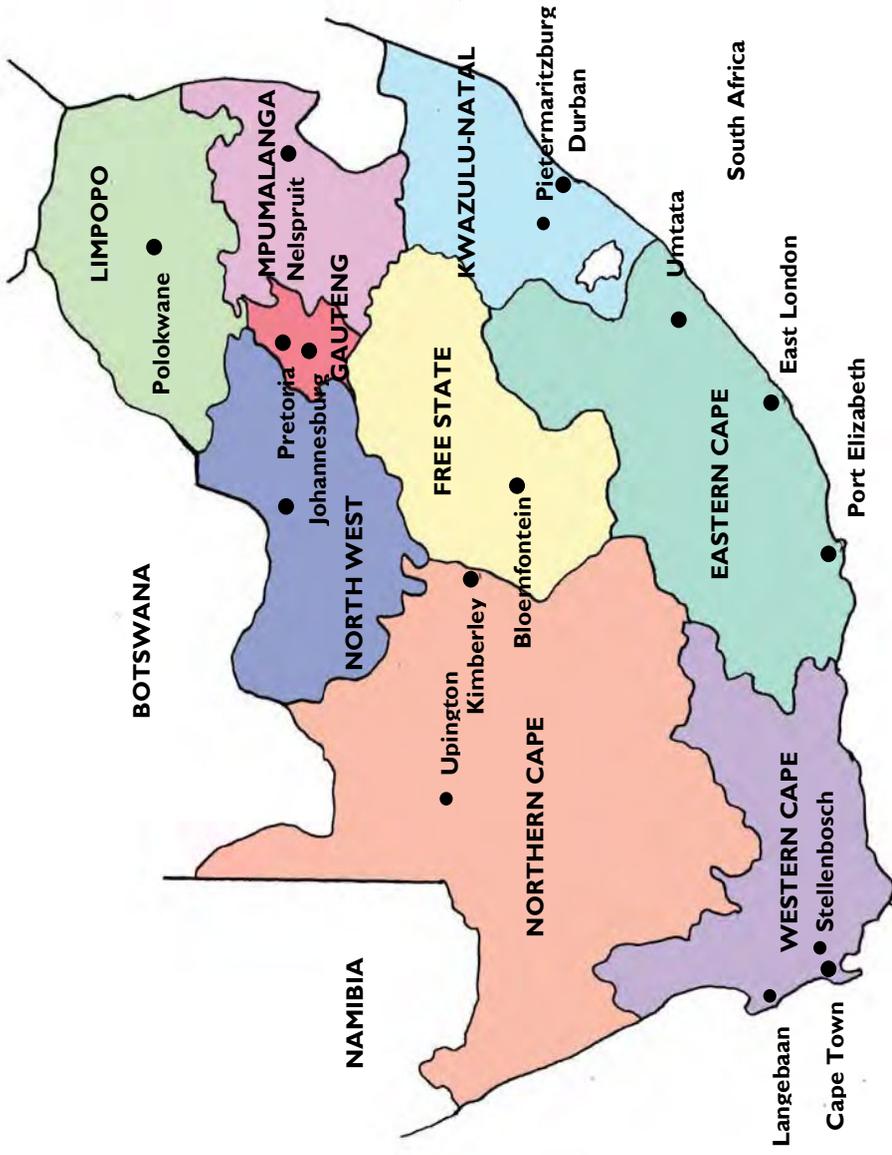
Case study 15
The Co-ordinated Avifaunal Roadcounts (CAR) project
 Case study by Tracy Bailey

This case study documents the initiation, progression and outcomes of a research project which focuses on one aspect of the environmental landscape in South Africa, namely the large terrestrial or ground-dwelling birds, such as Blue Cranes (our national bird), Stanley's Bustards, Abdim's Storks and Secretary birds, many of which are threatened or endangered. The project is the Co-ordinated Avifaunal Roadcounts (CAR) project at the Avian Demography Unit (ADU), University of Cape Town. The project focuses on monitoring the trends in numbers and habitat use of these bird populations, primarily on agricultural lands.

- ◀ Project leaders: Mr James Harrison & Mrs Donella Young (Avian Demography Unit, University of Cape Town)
- ◀ Scientific domain(s): Ornithology, statistical sciences
- ◀ Primary forms of knowledge utilisation: Advancement of knowledge; research to inform environmental planning and practice

Figure 1 is a map of South Africa showing the nine provinces and the towns or cities to which the case studies are related.

Figure 1: Geographic spread of the case studies



2 The case study methodology and process

Work on the case studies began in earnest in January 2003 and the final case study reports were submitted in September 2004.

There were four broad stages in the process of developing the cases studies, namely preparatory work; fieldwork, analysis and writing; finalisation of the case studies; and, the development of the case study synthesis. Table I below highlights the various project activities associated with each stage in the process.

Throughout the project, a number of meetings and workshops were held with the research team. These ranged from discussions of the knowledge production and utilisation themes emerging out of the literature and the survey component of the project, and the case study methodology; to the selection of case studies and the logistics of the fieldwork, and detailed feedback on first drafts.

Selected aspects of the case study process are discussed in detail below.

Table I: Stages and activities in the research process

Stage	Project activities
Preparatory work	Identified key issues that emerged from the literature review, the survey component and the industry interviews
	Identified the guiding principles for the selection of the case studies
	Developed a fieldwork protocol/manual that includes the objectives and key concepts for the study, the interview schedule, and a framework for the case study report. The protocol also addresses issues surrounding obtaining access to cases and research ethics.
	Identified potential case studies and requested co-operation from the relevant individuals
	Requested project documents (including proposals, reports, minutes of meetings, annual reports etc) and undertook preparatory documentary analysis
	Prepared interview schedules and made fieldwork arrangements
Fieldwork, analysis and writing	Conducted interviews and focus groups, made site visits
	Transcribed interview data
	Drafted case studies
	Draft case studies reviewed by the research team; two-day feedback workshop and identification of key issues and themes emerging
	Conducted additional fieldwork where necessary

Table I Continued

Stage	Project activities
Finalisation of case studies	Draft case studies reviewed and verified by participating project leaders/heads of department etc
	Formatting and style sheet developed and circulated to research team
	Revision of draft of case studies
Integrated case study report	Development of integrated report on case studies

2.1 The preparatory work for the case studies

Selection of case studies

There were a number of principles that guided the researchers in their selection of the case studies, and these were applied in research team meetings when the selection of case studies was under discussion. These guiding principles included the following:

- ◁ Disciplinary spread: The case studies together should cover all the major scientific domains, including the Natural Sciences & Engineering, the Social Sciences & Humanities, and the Health Sciences.
- ◁ Institutional spread: There should be a reasonable distribution of cases across historically advantaged and historically disadvantaged universities and technikons. Projects based at two science councils were also included based on the inherent interest of the individual cases.
- ◁ Theoretical relevance: Each case study should link up with key theoretical debates in the fields of Science & Technology Studies and Higher Education Studies.
- ◁ Forms of utilisation: The case studies together should reflect as many different forms of utilisation (identified in the literature review, see Volume 2) as possible (e.g. agricultural extension, research-for-policy, evidence-based practice, technology transfer)
- ◁ Thematic relevance: There should be validation and articulation with key utilisation themes emerging from prior studies, in each of the case studies, for example:
 - ◆ Intellectual property issues/patenting/licensing
 - ◆ Collaboration and university-industry partnerships
 - ◆ Spin-off companies/science parks, and
 - ◆ Strategic research alliances.

The point of departure for selecting the case studies was the database of research projects that was generated during the survey component of the broader study (see Volume 2). A filter was run on the original database in order to identify those projects that had indicated that some form of utilisation had occurred. A number of the research projects or programmes included in this volume were selected from the 'utilisation subset' identified as above.

Their own research interests and disciplinary backgrounds also guided researchers. So, for example, Gerrit Loots looked for projects in the agricultural field, given his background in farming, and Jaamiah Galant selected a research project within the field of mathematics education – one of her key research interests.

Some of the case studies were also selected because the researcher had close contact with the particular project or the project leader. For example, Leisl Bowers, who had worked previously at the Port Elizabeth Technikon, selected a case study in the Faculty of Electrical and Mechanical Engineering since she had developed a rapport with the project leader; while Tembile Kulati focused on the Centre for Higher Education Studies at the University of the Western Cape based on his close linkages to the centre and its staff.

In many instances, the research projects or programmes that form the focus of the case studies are large (in terms of size and/or funding) and usually well renowned, although some smaller projects are also included, especially where they represent a field or focus that is not present in any of the other cases.

The research team met frequently in these early days, in order to provide the Project Leader with progress on selecting the case studies, and to continue to discuss and clarify the selection criteria. This process enabled the team to identify gaps in the taxonomy of cases, which those researchers, who had still not identified appropriate cases, could pursue.

The fieldwork manual

During the time that the researchers were identifying and selecting their case studies, a few members of the research team worked to develop a fieldwork protocol or manual, whose purpose would be to provide the research team with detailed information and guidelines about the project, the fieldwork and report writing. The fieldwork manual includes the following sections:

- ◀ The broader project aims and how the case studies are located within these, as well as the specific research questions to be address by the case studies
- ◀ A summary of the key themes around knowledge production and utilisation in the literature, based on the literature review in Volume 2 of this report
- ◀ A detailed ‘fieldwork guide’: preparing for fieldwork, tips on conducting interviews, transcribing interviews and the format for transcriptions, and ethical issues
- ◀ A checklist table which researchers could use in selecting and developing their case studies
- ◀ The interview schedule (quite broadly conceived, given the diversity in the range of respondents), and
- ◀ A framework for the case study report.

Fieldwork preparations

Once the case studies had been selected and co-operation had been requested from project leaders and others, where necessary, the researchers then began to prepare for their fieldwork. This involved requesting all the relevant research project/programme and institutional documentation, developing the interview schedules for each participant, and arranging telephonic or face-to-face interviews and site visits, where applicable.

2.2 The fieldwork and development of first draft case study reports

For the most part, data sources included a combination of secondary sources (documents, web sites and statistics), and in-depth interviews (face-to-face or telephonic) with the head of the organisational entity within which the project or programme was located; the project leader(s) and other members of the team; and selected users of the research. In some cases, focus groups were conducted with groups of users and, in one case; classroom observations were added to the suite of methods used. Individual researchers were responsible for transcribing their own interview or focus group data.

In July 2004, the case study drafts were circulated to the entire research team and a two-day workshop (12 and 16 July 2004) was held in which detailed feedback was provided on each of the case studies. Where necessary, researchers returned to the field in order to fill in gaps or obtain further information or clarity, and the first drafts were revised on this basis.

2.3 Finalisation of the case studies

The revised first drafts of the case studies were sent to the relevant project leaders. The project leaders were asked to read through the case study reports to check for factual inaccuracies or misinterpretations, and to add any additional information or comments where necessary. During this time, a style sheet for the case studies was developed and circulated to the research team. Comments from project leaders were integrated into the final draft of the case studies.

CASE STUDY 1

LACTIC ACID BACTERIA RESEARCH

The fermentation of new ideas into winemaking

Three WINETECH-sponsored projects guided by Dr Maret du Toit from the Institute for Wine Biotechnology, University of Stellenbosch

by Nelius Boshoff



Interior of a San Antonio Abad Cooperativa Cellar, photograph courtesy of SAAC website [<http://www.vinos-saac.com/wines/index.htm>]

CONTENTS

Abbreviations	18
1 Introduction	19
2 The broader organisational context	21
2.1 Institute for Wine Biotechnology (IWBT)	21
2.2 Wine Industry Network of Expertise and Technology (WINETECH)	26
2.3 Background and activities of the project leader	32
3 Project 1: The role of microorganisms in the formation of bitterness in wines	33
3.1 Project history	33
3.2 Key project descriptors	35
3.3 Mode of knowledge production	35
3.4 Mode of knowledge utilisation	41
3.5 Comments about this project	50
4 Project 2: The occurrence of malolactic fermentation (MLF) in rebate wine and its influence on brandy quality	51
4.1 Project history	51
4.2 Key project descriptors	52
4.3 Mode of knowledge production	53
4.4. Mode of knowledge utilisation	58
4.5 Comments about this project	62
5 Project 3: Sources of acetic and other fatty acids and their role in sluggish or stuck fermentations	63
5.1 Project history	63
5.2 Key project descriptors	64
5.3 Mode of knowledge production	65
5.4 Mode of knowledge utilisation	70
5.5 Comments about this project	75
6 Insights derived from the three projects	76
6.1 Two project trajectories	76
6.2 Publications for the local winemaking community	79
6.3 Future research	80
Data sources	81
Face-to-face interviews	81
Telephonic interviews	81
E-mail response	82
Publications and documents	82
Websites visited	83

Appendix: List of project outputs	84
Project 1: The role of microorganisms in the formation of bitterness in wines	84
Project 2: The occurrence of malolactic fermentation (MLF) in rebate wine and its influence on brandy quality	84
Project 3: Sources of acetic and other fatty acids and their role in sluggish or stuck fermentations	85

Abbreviations

AAB	Acetic acid bacteria
ARC	Agricultural Research Council
CREST	Centre for Research on Science and Technology
CWSI	Cape Wine and Spirit Institute
DFPT	Deciduous Fruit Producers Trust
IWBT	Institute for Wine Biotechnology
LAB	Lactic acid bacteria
MLF	Malolactic fermentation
NRF	National Research Foundation
SASEV	South African Society for Enology and Viticulture
SAWB	South African Wine and Brandy Company
THRIP	Technology and Human Resources for Industry Programme
VA	Volatile acidity
WINETECH	Wine Industry Network of Expertise and Technology

1 Introduction

The South African wine industry is almost exclusively located within the Western Cape province of the country¹ and constitutes a R13 billion sector. It produces 3% of wine globally and in 2001 ranked ninth on the list of international wine exporters (SAWB 2003:1). As such, the local wine industry is an important component of the national economy.

For almost a decade now the South African wine industry has been in a process of transition: from a production-orientated industry to a market-directed enterprise. The general shift is one away from the production of basic commodity (bulk) wine to the production of high quality wine, with “quality ... defined as sustainable customer and consumer satisfaction” (Pretorius nd:2). No longer is it wine producers² who are setting the production agenda, but health- and environmentally-conscious consumers. This represents a global trend in the wine business. Moreover, the bulk wine category suffers from surplus production, with the result that more and more producers are entering the high quality wine category in order to ensure sustainable profitability. The industry is thus increasingly becoming competitive and customer-responsive. It is against this backdrop that the growing demand for research activity and technological innovation in the wine industry needs to be understood, as the winning advantages are expected to come from biotechnological advances. The following quote highlights the expectation:

[] there is no doubt that the application of leading gene technology in the wine industry holds breathtaking potential. In order to be technologically equal to the tremendous consumer challenge, the world's pacesetter wine industries increasingly are focussing on the genetic programming and improvement of the two main organisms involved in the production of wine, namely the grapevine and the wine yeast. (Pretorius nd:2)

The genetic improvement of grapevine cultivars and wine yeast constitutes the core of the research programme at the Institute for Wine Biotechnology (IWBT) at the University of Stellenbosch. In this report discussion will be devoted to three research projects of the IWBT that can be classed under the yeast development side of activities. Although not concerned with the genetic engineering of yeast *per se*, these projects contribute to the broader knowledgebase that eventually will inform the development of ‘ideal’ yeast strains with desired properties. Examples of targets for the genetic improvement of wine yeasts are improved fermentation performances, improved sensory wine quality and improved control of wine spoilage microorganisms (Pretorius nd:6-8).

¹ The wine industry in the Western Cape accounts for 91% of wine production (WESGRO 2000:3).

² There are four groups of wine producers in South Africa. They are (1) estate wineries, who make wine from grapes grown on their own land, (2) co-operative cellars, who communally produce wine from grapes grown by farmer member shareholders, (3) independent or private cellars, who buy in grapes from various sources, and (4) producing wholesalers, who also buy in grapes and wine from different sources, apart from growing their own grapes (<http://www.golfwinesouthafrica.com/sawine.php>). In 2002, there were 92 estate wineries, 50 co-operative cellars, 185 independent or private cellars, and 8 producing wholesalers (Ewert & Du Toit 2003:9).

However, we will not speculate about the long-term utility of the specific project findings within the overriding genetic improvement programme. The focus of the discussion is on the immediate application of the project findings within the South African wine industry. The three projects³ are:

- ◁ The role of microorganisms in the formation of bitterness in red wines
- ◁ The occurrence of malolactic fermentation in rebate wine and its influence on brandy quality, and
- ◁ Sources of acetic and other fatty acids and their role in sluggish or stuck fermentations.

A question may be raised as to why these three projects were selected. The answer lies in their commonalities. Apart from being based at the IWBT and sharing a project leader, all three projects required an investigation into lactic acid bacteria (LAB) and its role in fermentation and the quality of the end product. Our interest in LAB, as selection criterion, emerged from a Survey on Research Utilisation that was conducted in 2002 by the Centre for Research on Science and Technology (CREST), which indicated that the wine industry, to some extent, is using the research into LAB and winemaking. Another commonality is that the Wine Industry Network of Expertise and Technology, known as WINETECH, funded all three projects. WINETECH is the overarching R&D funding structure in the South African wine industry, which links the research performers to the industry partners.

Before discussing the project specifics, we will first sketch the broader organisational context. This calls for a discussion of the establishment of the IWBT, the creation of WINETECH, as well as the background and activities of the project leader.

³ Readers with an enquiring mind may rightfully ask: but where is the 'biotechnology' in these three projects? It is useful to refer to the typical classification of biotechnology, according to which the projects are examples of 'first generation' biotechnology. Specifically, "(f)irst generation biotechnology involves the use of wild type or natural biological organisms to produce a product, for example, the use of yeast to make beer or wine. Second generation biotechnology refers to the production of specific products using a pure cell or tissue culture of organisms that have been specifically selected, through random cross-breeding or similar techniques, for their superior production or expression abilities without introducing foreign DNA. Third generation biotechnology involves manipulation of the genetic make-up of organisms, by introducing selected foreign (across the species barrier) DNA, through recombinant DNA technology, to make them produce small molecules, compounds or proteins they would not normally produce" (NBS 2003:19).

2 The broader organisational context

2.1 Institute for Wine Biotechnology (IWBT)

The IWBT was created on 1 October 1995 within the Department of Viticulture and Oenology at the University of Stellenbosch, under the directorship of Prof Sakkie Pretorius⁴. The IWBT has a strong strategic position as a prominent producer of forefront knowledge and technology within the South African wine industry. Since its inception the IWBT has established itself as a centre of excellence in wine and grapevine biotechnology, nationally as well as internationally. The establishment of the IWBT goes back to the crisis in the local wine industry in the early 1990s, and the subsequent alignment of the industry within a common framework. A brief historical overview is therefore warranted.

Historical events that lead to the establishment of the IWBT

During the 1970s and 1980s foreign export markets increasingly became inaccessible to the South African wine industry due to sanctions and economic isolation. As a result the focus of the local wine industry was largely on the use of surplus stock. This impacted negatively upon the research and training of the then Department of Oenology at the University of Stellenbosch – surpluses constrained the introduction of new and desired cultivars to the market, which, in turn, limited research opportunities within the wine industry. Also, research funds were scarce. Thus the Department was under no pressure to improve its research performance, nor did large numbers of students want to pursue a career in oenology⁵.

In the early 1990s, when the international community reopened its doors for South African wine exports, the local industry experienced a major crisis: the demand for quality exports exceeded production by far. The crisis was exacerbated by the absence of a research and training infrastructure for the wine industry. While the Nietvoorbij Institute for Viticulture and Oenology⁶ in Stellenbosch did provide some research structure, the research staff at Nietvoorbij were expected to come from university. But up to 1995, in the history of the Department of Oenology at the University of Stellenbosch, only one PhD student had graduated. The head of that department was a retired professor who had

⁴ Prof Pretorius graduated from the University of the Free State in South Africa and obtained his PhD in microbiology from the Albert Einstein College of Medicine in New York. He was the first director of the IWBT from 1995 to 2002 and also a part-time professor in industrial microbiology at the Catholic University of Leuven in Belgium. His research focus has been on the genetic improvement of industrially important yeast strains (*Saccharomyces cerevisiae*) and grapevine cultivars and his teaching centred on molecular biology and genetics of yeasts/recombinant DNA techniques, applied wine microbiology and wine biotechnology. He has authored or co-authored more than 128 articles and book chapters, and has delivered more than 400 lectures at conferences and research seminars. He has supervised and co-supervised 15 PhD students and 52 MSc students. He is a world leader in his field, as reflected in the A-rating that he received from the National Research Foundation in South Africa (previously in microbiology but lately in wine biotechnology). Since 2003 he is Director of Research at the Australian Wine Research Institute and also an affiliate professor in the School of Agriculture and Wine at the University of Adelaide.

⁵ Oenology (sometimes spelt 'enology') is the study or art of winemaking.

⁶ The Nietvoorbij Institute amalgamated in 1997 with the Institute for Fruit and Fruit Technology (Infruitech), both located in Stellenbosch and belonging to the Agricultural Research Council (ARC). The amalgamated institute is known as ARC Infruitech-Nietvoorbij. According to their website, the institute is a world-renowned, one-stop research facility that generates cutting-edge technology for the South African deciduous fruit, grape, wine and brandy industries (<http://www.arc.agric.za/institutes/infruit/infruitmain.htm>).

been reappointed on contract for three years after retirement, as he was the only professor in oenology in the country. It was during this crisis period that the University of Stellenbosch approached Prof Pretorius, a young, leading scientist in microbiology (and only in his mid-thirties at the time), to offer him the professorship in oenology. He however declined the offer because he did not see himself as an oenologist. He nevertheless agreed to table a proposal that would help to kick start viticulture and oenology at both undergraduate and postgraduate levels, in order to meet the demands of the fast-growing wine industry.

Prof Pretorius' proposal, which he did not intend to implement personally at that stage because of promising career prospects in New Zealand, was to merge the Departments of Oenology and Viticulture, and to create a research institute alongside the combined department. Eventually he was persuaded by the University of Stellenbosch and wine industry to take up the position of director of the institute. There was however one major prerequisite: the alignment with the local wine industry. The process of aligning the wine industry, which gave birth to WINETECH, is described in Section 2.2.

The wine industry, through WINETECH, donated R5 million to start the IWBT, apart from agreeing to pay Prof Pretorius' salary. In fact, the wine industry appointed Prof Pretorius and permanently seconded him back to the University of Stellenbosch. Moreover, the University of Stellenbosch invested R6 million in the upgrading of the building in which the IWBT and the Department of Viticulture and Oenology are housed. The Technology and Human Resources for Industry Programme (THRIP)⁷ donated another R2.5 million. This amounts to R13.5 million invested in the establishment of the IWBT.

The nature and management of research at the IWBT

Prof Pretorius directed the IWBT for a period of seven years, from 1995 to 2002. After his departure for Australia, the reigns were taken over by an interim management committee consisting of the five most experienced researchers at the IWBT. These individuals, who are all still relatively young, gained their research and management skills under the direct guidance of Prof Pretorius.

In this section we take a closer look at the nature and management of research activities at the IWBT. Where possible, we will compare the circumstances at the time of Prof Pretorius' directorship to the prevailing circumstances. First, we consider the fundamental/applied research interplay.

⁷ THRIP is a partnership programme that challenges companies to match government funding for human resources development and R&D in South Africa, on a rand for rand basis (<http://www.nrf.ac.za/thrip/about.html>). The National Research Foundation (NRF) manages THRIP on behalf of the Department of Trade and Industry (DTI). The R2.5 million referred to here was a donation.

The fundamental/applied research interplay. During the seven years that Prof Pretorius directed the IWBT, he provided the vision and initial planning of all research projects. As director of the IWBT, Prof Pretorius' primary responsibility was that of a research programme leader:

I act as the programme leader. In other words, my main task is to detect problems in the wine industry through interaction with the wine industry – to identify problems, to translate and interpret these, so that we can put a research question and hypothesis on the table, to address that with a project. But in such a way that it is fundamentally enough because we need to deliver high quality masters theses and doctoral dissertations [] as well as top quality publications. (Sakkie Pretorius, interview (translated from Afrikaans))

What clearly emerges from this quote is the emphasis on the blending of fundamental and applied research activities within the research portfolio of the IWBT. The arrangement was largely influenced by Prof Pretorius' own research philosophy, which is detailed as follows on the website of his new employer, the Australian Wine Research Institute:

[Pretorius] believes that research should be a careful blend of fundamental and goal-orientated applied research. Therefore, basic and applied wine research should not be treated as separate ventures. His viewpoint is that wine research should be directed toward increasing fundamental understanding in a context responsive to the applied needs of producers and consumers at levels of both problem selection and experimental design. Therefore, he believes that wine research inspired by both the quest for understanding the fundamentals and by considerations of future use, promises to be the most powerful dynamo of technological progress that would support the cost-effective production of wine with minimised resource inputs, improved product quality, increased health benefits and low environmental impact. (<http://www.awri.com.au>)

Fundamental research, as implied in the previous two quotes, is perceived as an advanced scientific understanding of the issues underlying a research problem, as well as the generation of quality output based on the insights gained. Where the advanced knowledge is directed at problem solving within the wine industry, the research is also seen as goal-orientated applied research.

During Pretorius' time, the overarching research focus of the IWBT was on the genetic improvement of wine yeast and grapevine cultivars, which consisted of two sub programmes: yeast wine biotechnology and grapevine biotechnology. There was no explicit reference to the fundamental/applied distinction in the packaging of the programme. Under the new management committee the research programme is still the same (improvement of grapevine cultivars and wine yeast) but the breakdown now is in terms of fundamental and applied research projects. In particular, a biotechnology programme is associated with the applied side of activities and a molecular biology programme with the fundamental work. According to the current IWBT website:

The core of our applied research (Biotechnology programme) relies heavily on our fundamental investigations (Molecular Biology programme) funded by

the National Research Foundation (NRF) of the unravelling of metabolic fluxes, signalling pathways and gene regulation and expression in grapevine and yeast. Indeed, the understanding of the complex mechanisms by which grapevine plants and yeast cells adapt to a continuously changing environment (both physical and chemical) during cultivation and fermentation respectively leads to better targeted and more successful applied research programmes. (http://www.sun.ac.za/wine_biotechnology)

On the basis of this excerpt one could argue that biotechnology, as expressed in the name of the institute, is meant to indicate applied research of a special nature, namely applied research programmes that are informed by cutting-edge fundamental research. On the other hand, one must be cautious and not make too much of this explicit distinction between fundamental and applied research, as it was probably introduced to coincide with differences in the source and targeting of funding: government for fundamental research and industry for applied research.

What could be said, however, is that the blending of fundamental and applied research activities has not been restricted to the directorship of Prof Pretorius. It still continues and is also echoed by Dr Maret du Toit (see Section 2.3), a member of the management committee and the project leader of the three projects that constitute the core of our investigation:

The institute's main focus is biotechnology but because we are closely linked to the wine industry with regard to research, some projects are not strictly fundamental or biotechnological. But it is important to have a foot in the application as well because there are many practical problems in the industry that are passed on to us to answer and [] we then usually select the stuff that is most important to us and which will also produce enough data from a research perspective for our students to eventually graduate. So, I don't think a distinction should be made between fundamental and application. Both have their respective places in the institute's research programme and portfolio. (Maret du Toit, interview (translated from Afrikaans))

Sources of research funding. Funds for the IWBT research programme are obtained annually on a competitive basis through submissions to various institutions. Research of a more applied nature is funded by the wine industry (through WINETECH), the deciduous fruit industry (through DFPT – the Deciduous Fruit Producers Trust), and two yeast industries (Anchor Biotechnologies and Lallemand). Because of these industry sources of funding the IWBT are also entitled to THRIP funding from government. Between 1997 and 2002, the amount of THRIP funding allocated to the IWBT increased from R220 thousand to almost R2.5 million. This represents a change from 2.7% to 11.2% of all THRIP funding received by the University of Stellenbosch in 1997 and 2002 respectively (THRIP 1997, 2002).

As indicated, fundamental investigations are funded by the NRF through participation in the latter's focus area programmes. The NRF is also an important source of funding for student bursaries.

Postgraduate training and the utilisation of students as research workers. The IWBT provides training in a postgraduate programme in wine biotechnology, consisting of an honours degree (BScAgric [Hons] or BSc [Hons]), master's degree (MScAgric and MSc) and doctoral degree (PhD [Agric] and PhD). The honours degree is a crash course in the absolute essential components of the 4-year undergraduate BScAgric degree that are offered by the Department of Viticulture and Oenology. Students from any university with a relevant degree in agriculture, science, engineering, or even medicine, may enrol for the honours degree and from there on move to a masters and eventually a doctoral degree in wine biotechnology. This route allows more students to follow a career in wine related research. At present the IWBT has 26 masters and 12 doctoral students enrolled.

The postgraduate students at the IWBT therefore have a foundation in a variety of disciplines, such as Viticulture and Oenology, Microbiology, Biochemistry, Chemical Engineering, Chemistry and Genetics. They spend 100% of their time at the IWBT. Apart from enlarging the pool of research workers, the incorporation of students from other disciplines also says something about the nature of the industry-related problems often presented to the IWBT. In Pretorius' words:

[] a problem in the wine industry does not present itself as a microbiological problem or a chemical problem. It comes as a problem and you usually need a number of inputs from different disciplines to address it. (Sakkie Pretorius, interview (translated from Afrikaans))

The Department of Viticulture and Oenology, to which the IWBT is attached and within which three of the five senior researchers are appointed as academic staff, is the place where the postgraduate degree in wine biotechnology is located. The reason is that, in most cases in South Africa, university research institutes are not allowed to award postgraduate degrees. Only university departments can do so. Strictly speaking then, the IWBT manages the course on behalf of the Department of Viticulture and Oenology. The latter department also has its own postgraduate programmes, respectively in viticulture and oenology. Those IWBT staff members with dual appointments (as researcher at the IWBT and as lecturer at the department) thus have two pools of postgraduate students to select from for project activities – either the viticulture/oenology pool or the wine biotechnology pool:

There are [] separate research foci in the institute and the department. The kind of projects conducted by students in the department eventually would be more applied than fundamental because the students do not have the foundation. They come from a viticulture and oenology undergraduate programme, which normally isn't much molecularly orientated. So it takes them longer to get to answers than it would take students who enter from the institute side, who do have molecular exposure somewhere in their undergraduate studies. So I have students who are completely part of the institute and I have students who are completed part of the department. As I say, the kind of projects in the department is more aimed at short-term problem-solving for industry. (Maret du Toit, interview (translated from Afrikaans))

Thus, although both fundamental and applied research are linked to postgraduate training, the research work of the IWBT is seen as more fundamental. The reason is that the IWBT students usually have exposure to molecular work, which they acquired during their undergraduate studies (e.g. in microbiology).

Lastly, the training of large numbers of students from various disciplines, together with significant bursary and research funding, have necessitated the introduction of two sets of structures at the IWBT. The first is a structure of roles, based on rank, to ease the workload of the five project leaders (of which three are also lecturing staff in the Department of Viticulture and Oenology). This boils down to a three-layer structure, with a layer of postdoctoral fellows between the project leaders and the students, to assist the project leaders with supervision in the laboratory. The second structure is an administrative and financial system for research and postgraduate activities.

Research dissemination and output. There is a competitive publishing culture within the IWBT. All five senior researchers and their postdoctoral fellows regularly publish articles in accredited scientific journals and contribute chapters to books as well. The same productivity and zeal apply to paper and poster presentations at national and international conferences. Students are also actively encouraged to publish in scientific journals and to present papers. As a rule of thumb, a master's thesis should generate at least one article in an accredited journal and a doctoral dissertation at least two or three articles.

Apart from disseminating knowledge to academic and scholarly audiences, there are also disseminations to the wine industry. For instance, project leaders who receive WINETECH funding are encouraged to publish one technical article in a popular journal that is partly sponsored by WINETECH. More about the journal will be said in the next section on WINETECH.

2.2 Wine Industry Network of Expertise and Technology (WINETECH)

Origin, objectives and structure of WINETECH

In the early to mid-90s the South African wine industry was largely fragmented and characterised by internal politics and rivalry. Prof Pretorius, very much aware of the fact that research quality and the building of a research reputation require a focused, long-term programme, agreed to become the director of the IWBT on condition that a shared vision for the industry be formulated. This called for the identification of common growth objectives. Without mutual goals, Prof Pretorius realised that the priorities for the wine industry would fluctuate each year, resulting in a fragmented research programme. From the start he emphasised that the IWBT would not conduct research on an *ad hoc* trouble-shooting basis. There must be a research programme that is based on common growth objectives, where the latter had been defined and agreed upon by all industry stakeholders.

Once a shared vision for the wine industry had been formulated, Prof Pretorius recommended that a united body be created within which the wine industry could materialise the growth objectives. This resulted in the creation of WINETECH. It is a generic structure with no personnel, apart from an executive manager (previously an executive director) and a technical assistant. It is a 'virtual organisation' that consists of

business people and scholars who sit on committees, all with a strong interest in improving the competitive position of the local wine industry. WINETECH has six broad objectives, which are summarised as follows (<http://www.winetech.co.za/>):

- ◀ To support the wine industry with expertise, enabling it to be cost effective while producing quality wines and other grape based products through the application of environmentally friendly technologies;
- ◀ To support the training and education of individuals for the industry – at all levels in terms of skills, knowledge and insight development – in order to ensure the practical implementation of the best knowledge and most advanced technologies in viticulture, wine making and other grape based products;
- ◀ To establish a culture of technological innovation, to ensure the ongoing utilisation of the best technology within the industry, and to facilitate its dissemination to all the sectors of the industry;
- ◀ To facilitate the development of resource poor and previously disadvantaged producers and to improve their access to the industry by making appropriate cutting edge technology available to such producers;
- ◀ To establish world leadership in selected niche areas of the wine industry through WINETECH'S network of scientific and technological expertise, and
- ◀ To commission relevant and thoroughly planned research, technology development and technology transfer in the promotion of the industry's technological capabilities and in the attainment of the other objectives.

WINETECH's structure, as Prof Pretorius initially had visualised it, consisted of three layers: programmes, projects and tasks (Sakkie Pretorius, interview). The programmes (top layer) represented the opinion formulators in the wine industry (i.e. CEOs of companies and chairs of influential wine societies), organised within an executive council. They were the ones responsible for strategic planning in the wine industry in the long term. Their purpose was to identify the market-pull forces. At the bottom were the contractors. The main players were the University of Stellenbosch, ARC Infruitec-Nietvoorbij and the Elsenburg College of Agriculture⁸. They provided the technology push. The middle layer was divided into five technical committees: viticulture, oenology, technology transfer, training and marketing. Two-thirds of members of these committees were from the wine industry, and one-third from academic and research institutes (e.g. Stellenbosch University, ARC Infruitec-Nietvoorbij and Elsenburg College of Agriculture).

Today there are only four technical committees (marketing has been dropped) and the representatives are all experts from industry. For instance, the Oenology Committee comprises eight members, who represent two of the most important stakeholders in the local wine industry – the Cape Wine and Spirit Institute (CWSI) and Cape Negotiants. In the bottom layer, Stellenbosch University and ARC Infruitec-Nietvoorbij are still

⁸ The Elsenburg College of Agriculture, situated outside Stellenbosch, resorts under the Western Cape Department of Agriculture. According to its website, Elsenburg is one of the leading agricultural training institutions in South Africa. A major achievement in its recent history was the introduction of a diploma qualification in Cellar Technology in 1976. As from this year (2004) it also offers a BAgric qualification in collaboration with the University of Stellenbosch (<http://www.elsenburg.com/>).

among the most frequently contracted research performers, together with the Universities of Cape Town and Pretoria, but Elsenburg does not feature on the list of current R&D partners.

The most significant changes, however, occurred in the top layer. Towards the end of 2003 WINETECH was incorporated into the structure of the South African Wine and Brandy Company (SAWB). The latter is a Section 21 company⁹ that was established in October 2002, because of a strategic study (***Vision 2020: Creating the Future of the South African Wine Industry***) that WINETECH had commissioned in 1999. The SAWB is the new representative structure in the wine industry, consisting of four stakeholder groupings or chambers (wine farmers, labour, cellars and trade). It has drawn up a strategic plan to achieve a “vibrant, united, non-racial and prosperous” wine industry (SAWB 2003). The strategy has six broad goals, each with its own (but integrated) industry programme. These are:

- ◀ Economic development and empowerment
- ◀ Social development and upliftment
- ◀ Human resources development and training
- ◀ Market development and promotion
- ◀ Knowledge and information development, and
- ◀ Technology innovation and transfer.

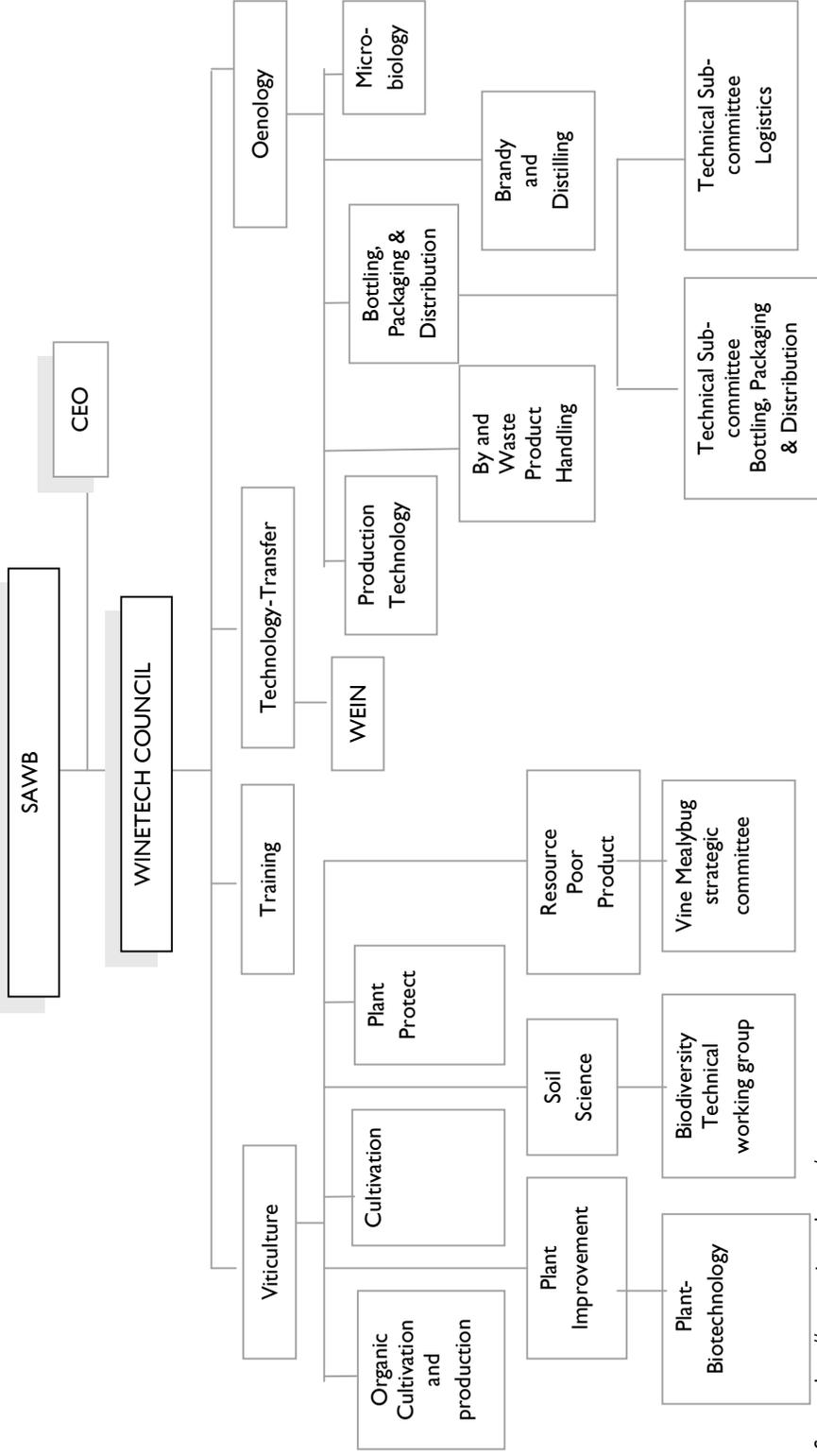
WINETECH has been tasked with the implementation of the technology innovation and transfer strategy. At its core, the strategy is about:

[] the establishment of problem solving market directed and socially and environmentally responsible technology innovation and development and transfer systems. (SAWB 2003:iii)

As part of the SAWB structure, WINETECH is overseen by the SAWB Board, which comprises 20 representatives from the four SAWB chambers. There is also a WINETECH Advisory Council, to assist the executive manager of WINETECH in the implementation of the SAWB strategy. This advisory body consists of one expert from each of the four WINETECH technical committees, as well as the CEO of the SAWB and the executive manager of WINETECH. An organogram of WINETECH is portrayed in Figure 1.

⁹ A section 21 company is similar to a normal profit company but is not allowed to operate to make a profit and cannot share the profits out among the company members. Large organizations that run big programmes and budgets usually set up a section 21 company (<http://www.paralegaladvice.org.za/docs/chap15/16.html>).

Figure 1: WINETECH organogram



Source: <http://www.winetech.co.za/>

The evaluation, selection and monitoring of research projects occur at the level of the technical committee. Generally a researcher submits a concept project proposal, which is evaluated by the technical committee concerned. A meeting with the researcher to clarify the details of the proposal follows this. If approved, the researcher is asked to submit a formal application for project funding. Once granted, a researcher must submit progress reports on an annual basis. According to Dr Gert Loubser, the chair of the Microbiology Committee (a specialist committee of the Oenology Committee) the progress reports are evaluated by the committee according to a number of criteria:

The progress reports [] go to the committee. The committee looks at it and then decides, you know, if – number one –we are satisfied with the progress made because money has been paid, the institute has done the research and are we satisfied with what we got [] The second aspect is that we have to check whether the line for future research, you know, the direction in which the project is moving, whether we are satisfied with it, that the institution is not taking another direction, you know, that deviates from what we originally saw fit because we then have to decide whether or not we are going ahead with the research. (Gert Loubser, interview (translated from Afrikaans))

A final report is submitted when the project is completed. There are prescribed templates for applications and reports. There are also face-to-face meetings with researchers where feedback is provided. These meetings occur during the second half of the year, and per institution. For instance, the IWBT will be visited and all the researchers with WINETECH funding will give their project feedback at that meeting. Market-driven considerations, with a focus on innovation, play a strong role in the selection of funding applications:

WINETECH acts in the interest of the SA Wine Industry and will be guided, in the consideration of any application, by whether the specific research, technology transfer or training will contribute to the creation and application of technology which may result in winning advantages in the market place. (www.winetech.co.za)

Apart from being an R&D funding body, WINETECH is also perceived as a major structuring and directive force within the wine industry, at least as far as research is concerned. As Dr Maret du Toit puts it:

I think WINETECH has given structure to the research in the industry and I mean [] they are one of our [IWBT's] primary funders. Apart from that WINETECH also created opportunities for forums where people can [] the researchers in the wine industry can get together and put their ideas on the table so that there is a more focussed attempt. Not every guy doing his own thing and then you also come and try to do it in your own way. So I think for the industry as a whole WINETECH contributed positively to the promotion of research within the wider industry. But [] primarily they give the funding. (Maret du Toit, interview (translated from Afrikaans))

This quote highlights the coordinating and steering role that WINETECH plays in the initiation and conduct of wine research in South Africa. But to what extent does

WINETECH also steer and direct the dissemination of research findings? The next section provides some answers.

WINETECH and the dissemination of project research findings

WINETECH provides a detailed set of guidelines for its funding applications – one of these actively encourages the dissemination of research findings. It states that:

The results of all WINETECH funded research projects must, if possible, be presented to the end-users in the industry, be published in at least one scientific and one popular magazine. (<http://www.winetech.co.za/>)

WINETECH sponsors a section in **WineLand**, a popular wine magazine that is published by VinPro, the South African wine farmers' service organisation. The section sponsored is known as **Wynboer Tegnies / Technical**. It is a technical guide to South African wine producers. According to a survey that **WineLand** recently conducted among its readers, **Wynboer Tegnies / Technical** was considered to be the second most important section in the magazine, attracting 74% of votes (WINETECH 2003:14). This implies that almost three-quarters of the readership of **WineLand** value the contributions in **Wynboer Tegnies / Technical**. Thus, the technical section is an important channel for technology and knowledge transfer of WINETECH funded research projects.

Who reads **WineLand**?

- Wine farmers – The Cape's 4 700 wine farmers are all subscribed and form the largest single segment of readers.
- Wine marketers read the magazine to keep pace with production and consumption patterns in South Africa and abroad.
- Decision makers in the industry – These include the boards and management of the major producer-wholesalers like KWV, SFW, Distillers Corporation, Gilbeys and Douglas Green Bellingham, as well as the owners of the country's more than 90 registered wine estates, more than 140 private cellars, as well as some 70 co-operative wine cellars which produce 85% of the country's wine.
- Researchers and students – WineLand serves as reference for researchers and others involved in the wine technical field, as well as students at the Department of Viticulture and Oenology at the University of Stellenbosch and other educational institutions.
- Parliamentarians and envoys – The magazine is also mailed to parliamentarians in the country and all South African embassies abroad.
- The editorial content is a balanced mix to satisfy the needs of farmers, cellar masters, students of wine and serious wine consumers. Articles and news items of general interest appear in the front half of the magazine, followed by those of a more scientific or technical nature, and items on leading suppliers to the industry.

Source: <http://www.wineland.co.za/whoreads.php3>

WINETECH also sponsors the **South African Journal of Enology and Viticulture** as part of its technology transfer programme. This peer-reviewed, scientific journal is generally known as the SASEV journal, since the South African Society for Enology and Viticulture (SASEV) publishes it. In 2003, 10 scientific publications resulted from

WINETECH sponsored research projects. Of these, 6 were published in the SASEV journal. The corresponding figure for 2002 was 8 out of 10 publications (WINETECH 2003:12). This illustrates the importance of the SASEV journal in the dissemination of WINETECH funded research findings to local scholarly audiences and winemakers.

Moreover, WINETECH sponsored research projects are presented at SASEV conferences. The aim of SASEV is:

[] to serve as a forum for making the latest relevant scientific knowledge available to all South African wine and grape producers; optimizing the quality of S.A. grapes, wines and related products constantly and distributing this technology internationally. (<http://www.sasev.co.za/>)

WINETECH also hosts information meetings in cooperation with the SASEV's Viticulture and Oenology Forum, and other bodies, where project findings are often presented to end-users. Feedback to end-users is important, given that WINETECH is funded through a voluntary industry levy and therefore accountable to its industry stakeholders.

In sum, WINETECH appears to be actively involved in the facilitation and encouragement of research dissemination. Its funded researchers – like Dr Maret du Toit – are well aware of the expectation that WINETECH holds of them in this regard:

They (WINETECH) expect that we present at forums to inform people, the wider industry – the farmers, the winemakers, the viticulturists – so that they are aware of what is forthcoming in research. (Maret du Toit, interview (translated from Afrikaans))

Thus, WINETECH provides its funded researchers with a ready-made forum for dissemination and potential utilisation of their research.

2.3 Background and activities of the project leader

Dr Maret du Toit is a microbiologist by training. She obtained her PhD in 1998 from the Department of Microbiology at the University of Stellenbosch, under the supervision of Prof Leon Dicks, who specialises in LAB. The title of her dissertation was: "Isolation, identification and characterisation of lactic acid bacteria with potential probiotic characteristics". After graduation, she couldn't continue with a post-doctoral fellowship in the Department of Microbiology. The reason was that the NRF does not support someone in a postdoctoral fellowship at the same department where the doctorate was obtained. Hence, Dr du Toit enquired about other vacancies and encountered Prof Pretorius. Prof Pretorius offered her a post-doctoral fellowship at the IWBT and she accepted. In 2001 a post of senior lecturer became vacant at the IWBT. Dr du Toit applied and was appointed. She has since worked within the yeast biotechnology side of activities at the IWBT and her niche within the overarching research programme has been clearly defined:

I felt that when I came here (to the IWBT), that there is a leg for me in yeast-biotechnology because some of the metabolites, which produce the lactic acid bacteria, can also be put into the yeast, which eventually can be used in the winemaking process; for instance, to counteract the control of

lactic acid bacteria spoiling organisms. (Maret du Toit, interview (translated from Afrikaans))

Over the last few years, Dr Maret du Toit has successfully applied her microbiological training and knowledge of LAB to the wine making process (fermentation, preservation etc.). LAB not only represents her research passion but also provides an opportunity to sustain an own identity at the IWBT.

This particularly has been made possible because of

- 1) a constant quest for advanced knowledge relating to the role of LAB in the wine industry and
- 2) the distribution of research foci at the IWBT, with four of the five senior researchers working on the yeast related side of activities and one on the grapevine side¹⁰:

I [keep] my passion going because there are fundamental questions regarding lactic acid bacteria and their role in the industry and we are four people in the institute who focus on yeast. It gives me that little extra room and space to maintain my own leg [of research] and identity. (Maret du Toit, interview (translated from Afrikaans))

Dr du Toit currently teaches one postgraduate and two undergraduate semester subjects within the Department of Viticulture and Oenology, as well one subject within the IWBT postgraduate programme. As far as supervision load is concerned, she is responsible for one honours, four masters and three doctoral students.

3 Project 1: The role of microorganisms in the formation of bitterness in wines

3.1 Project history

In 2000, Prof Pretorius invited each project leader at the IWBT to co-author with him a scientific article to celebrate the institute's five years of existence. The one by Dr du Toit was about the microbial spoilage and preservation of wine. The article was distributed to the conferees at the annual meeting of SASEV, as part of the content of their conference bags. At least one of the winemakers, who attended the conference, approached Prof Pretorius afterwards with the request to do a more in-depth analysis of the problem of bitterness in wine. The reason for the concern was that a number of prestige wines, those that received the Veritas¹¹ seal for excellence in the late-nineties, had suddenly acquired bitterness in taste.

¹⁰ Apart from Dr Maret du Toit, the three other researchers who work on the yeast side of activities are Prof Florian Bauer (yeast molecular biology), Dr Ricardo Cordero Otero (yeast biofuel biotechnology) and Dr Pierre van Rensburg (yeast wine microbiology). Prof Melané Vivier works on grapevine molecular biology, and is the chair of both the IWBT and the Department of Viticulture and Oenology (http://www.sun.ac.za/wine_biotechnology).

¹¹ The Veritas Awards - presented annually by the South African National Wine Show Association (SANW) - is the country's most representative and comprehensive competition for wines currently on the market (<http://www.veritas.co.za/>).

This was especially the case for Pinotage wines, and hence the Pinotage Association¹² of winemakers supported the investigation (see Section 3.4). Dr du Toit subsequently formulated a concept project proposal, which was submitted to WINETECH.

The initial proposal only focused on the role of lactic acid bacteria (LAB) in bitterness in wine, i.e. it only had a microbiological focus. Prior to the project, the ARC Infruitec-Nietvoorbij had also been working on the bitterness problem. Their orientation was more towards the chemical processes involved in the winemaking process. This ARC project, however, was stopped by WINETECH prior to Dr du Toit's proposal, as the findings did not really provide an answer to the bitterness issue. At that same time, research of a French origin had started to appear on the Internet, which implicated LAB as a cause of bitterness. Dr du Toit's project therefore only considered the role of LAB at first.

However, in discussions with WINETECH it was soon realised that the project would only come to its full potential if there were standard analytical tools to measure bitterness. Since the ARC Infruitec-Nietvoorbij had already been working on the development of an analytical facility, they were considered an obvious partner for collaboration. Hence, the ARC came on board and the next logical step was to add to the project their chemically orientated work on bitterness. It was believed that by looking at the problem from both a microbiological and chemical perspective, together with analytical tools, the search for answers would be accelerated.

Yet another leg was added, namely the influence of yeast on bitterness in wine. The motivation was largely a scientific one: yeast has the ability to produce glycerol, which, in turn, plays a role in the disintegration of bacteria into a bitter complex. This part of the project was also allocated to the ARC Infruitec-Nietvoorbij. Since the yeast component involves a small-scale production of wines, which must be analysed in terms of bitter compounds, it made common sense to have both the production and analytical facilities at the same site.

The project, as approved by WINETECH, is structured according to the three main tasks:

- 1) a study on the influence of yeast on bitterness in wine,
- 2) an investigation into LAB as a possible cause of bitterness in wine, and
- 3) the development of analytical tools to measure bitterness. The chemical aspects are part of all three tasks.

Dr du Toit oversees task 2, the microbiological one, and acts as the overall project leader. Two individuals at ARC Infruitec-Nietvoorbij are responsible for tasks 1 and 3.

The Microbiology Committee of WINETECH, a specialist subcommittee of the Oenology Committee, is responsible for evaluating the merits, progress and continued funding of the project. The project officially started in 2001 and will be finished by the end of 2004.

¹² The Pinotage Association, which started in 1995, is a body dedicated to the promotion and advancement of Pinotage. Pinotage is a uniquely South African grape variety. Anybody who has an interest in the production and marketing of Pinotage grapes and Pinotage wines can join the association. Most of the winemakers who produce Pinotage wines in South Africa are members. Other members include growers of Pinotage grapes, as well as researchers, viticultural consultants and marketers of Pinotage (<http://www.pinotage.co.za/>).

3.2 Key project descriptors

Project objectives

The project objectives are summarised as follows in the 2002 progress report to WINETECH, which was written by Dr du Toit:

Certain South African red wines are more prone to possess unacceptable levels of bitterness and have led to great economical losses, as these wines have to be disposed. The first objective of this project is therefore to determine whether bitterness in red wines is due to certain bacteria or yeasts or if these microorganisms are partly responsible for this defect in wine. Secondly analytical tools have to be developed to assess the influence of bacteria or yeast on the quality wine and concomitant the chemical changes that occur in bitter wines. (WINETECH progress report 2002b)

Size and composition of team

There are three tasks leaders in the overall project, working respectively on the role of yeast in bitterness (Dr Neil Jolly, ARC Infruitec-Nietvoorbij), the role of LAB in bitterness (Dr Maret du Toit) and the development of analytical tools to measure bitterness (Mr Philip Minnaar, ARC Infruitec-Nietvoorbij). A postgraduate student, Ms Shanon Krieling, in fulfilment of the requirements of her MSc degree, conducted the research task of interest, the one on LAB.

Sources of funding

It is a WINETECH funded project, which therefore also generated THRIP funding. In addition, the master's student, Ms Krieling, received a postgraduate bursary from the NRF, as well as funding from the NRF in the scarce skills category.¹³

Project outputs

The project is still ongoing. Ms Krieling conducted the core of the LAB task in 2001 and 2002. Apart from annual progress reports to WINETECH, the LAB task has only one significant written output, namely the MSc thesis of Ms Krieling. A scientific article is currently being written for publication in an international journal. A more popular kind of article is planned for publication in **Wynboer Tegnies / Technical** towards the end of 2004. Moreover, the investigation resulted in two presentations at South African conferences, and two at international conferences. The details of these presentations and Ms Krieling's MSc appear in the appendix.

3.3. Mode of knowledge production

Two lenses seem particularly useful in looking at the knowledge production aspects of the LAB task within the bigger project. These are the nature of the research interactions, and the utilisation of the postgraduate student as the primary research worker.

¹³ The NRF supports students in areas where there is a perceived scarcity of skills, especially if the students are black or female. The funding for this support category has been made available by the National Department of Labour.

Nature of research interactions

Three kinds of research interactions can be seen on the LAB side of the project:

- a) between the LAB task leader and the other two task leaders,
- b) between the LAB task leader and the postgraduate student responsible for the research, and
- c) between the LAB research worker (primarily the postgraduate student) and the project participating winemakers.

These we have dubbed respectively as horizontal research worker interactions, vertical research worker interactions, and research worker-user interactions.

Horizontal research worker interactions. As indicated, the other two research tasks on the project (the investigation into the influence of yeast on bitterness, and the development of analytical tools to measure bitterness) are both located at the ARC Infruitec-Nietvoorbij. The reasons for the IWBT's collaboration with the ARC Infruitec-Nietvoorbij on the project have been mentioned in Section 3.1. WINETECH encouraged collaboration between these two institutions in order to reduce an overlap in research focus and to complement research activities.

But what is the nature of collaboration between the ARC Infruitec-Nietvoorbij and the IWBT on this project? Do the three task leaders conduct their activities in an integrated sort of way or are the tasks being run as separate legs of a bigger project? Most of the time, however, the latter seems to be the case. According to Dr du Toit:

Every task basically has a leader. Those people are responsible for the milestones, which they put in for the year before the report is submitted. Because I am the project leader I get everyone's data together, integrate it and then the report is submitted. So, I don't have to check up on people and tell them that they are responsible for a specific task as planned. (Maret du Toit, interview (translated from Afrikaans))

Dr Jolly, the task leader on the yeast side of the project, echoes this:

With Maret [Dr du Toit] there's no sort of schedule that we meet specifically every week or every second week, but when necessary, when [] the three legs, a lot of the work is done independently. But where we have to, where the legs sort of cross and where we have to do, say one thing, and then pass it on to say Maret's group to carry on with, then obviously we have much more contact. (Neil Jolly, interview)

From Dr Jolly's response it is clear that there are no regular project meetings, only contact sessions as needed. Moreover, the amount of interaction between the task leaders appears to be largely determined by the development stages of the project. Now that the project is approaching its end stage, more frequent interaction is required. In this final phase, Dr du Toit must use the analytical tools developed by Mr Minnaar to analyse the bacteria in Dr Jolly's small-scale wine fermentations (WINETECH progress report 2002b). The present year has therefore seen much more interaction than the previous years. No interview was conducted with Mr Minnaar on the collaboration issue, but Dr Jolly indicated that he and Mr Minnaar work in the same building at the ARC Infruitec-Nietvoorbij and for that reason have frequent contact.

The compilation of the WINETECH progress reports happens in an independent sort of way. Up to now each task leader has:

written [] his [or her] own section, compiled the whole thing with the graph and everything, and then that gets taken up into the final document and you just then edit, and make sure that everything is taken up correctly [] Obviously the first [] year there wasn't so much interaction. This year there has been much more interaction so we will have to [] see how we deal with that section of the work [in the final report to WINETECH]. (Neil Jolly, interview)

An important aspect of the collaboration between the task leaders – and crucial for our study – is to what extent the final project results will be integrated. In this respect, Dr Jolly indicated that some of the ARC Infruitec-Nietvoorbij findings would eventually be integrated with that of the IWBT:

Because finally the whole thing is one issue, bitterness in wine. And every component plays a role. Thus obviously, say development of a technique to measure bitterness, for instance, could be published on its own. But the final solution would have to be all integrated together. (Neil Jolly, interview)

Asked whether the findings would be integrated in an article, Dr Jolly responded as follows:

There is a possibility, yes. Look it's really difficult to say at this stage. One would have to see what the final results are. (Neil Jolly, interview)

According to Dr du Toit the LAB task is the furthest ahead in terms of generating sufficient data for an article. The results of the LAB task will therefore also be the first to be published in the form of a scientific article. Because the academic and scientific environment within which the IWBT functions is rather competitive, the results cannot be held back until the other two tasks have also generated sufficient data.

In conclusion then, on the issue of collaboration between the task leaders, one could say that the three tasks are conducted more or less independently of each other, except where the work plan stipulates that there should be some form of interaction. The integration of the findings from the different tasks in a single article is a strong possibility, but has not yet been decided upon.

Vertical research worker interactions. Vertical research worker interaction implies that there is some sort of hierarchy in the research relation. In this project, specifically the LAB side of the project, there was interaction between an established project/task leader (Dr du Toit) and a postgraduate student in training (Ms Krieling). The term 'supervision' best captures the research relationship between the project leader and the postgraduate student. Nevertheless, we will refer to this relationship as vertical research worker interactions, given that the student was the primary research worker on the LAB task of the project and hence interacted with Dr du Toit in the latter's capacity as both task leader and overall project leader. The interaction was largely in the form of laboratory feedback and advice sessions, as well as joint authorship. This will be dealt with in more

detail in Section 3.3, where the discussion is about the postgraduate student as the primary research worker.

Research worker-user interactions. Winemakers are the intended users of the research results. The involvement of five winemakers (all from established wine estates) in the study is closely tied to the project history, as illuminated in Section 3.1. These winemakers, to different degrees, previously had experienced a problem of bitter wines in their cellars and for that reason availed them for participation in the research project. One of the participating winemakers was from outside the Stellenbosch wine route to cater for the fact that different climate zones have different impacts on bacterial growth. The main reason for participation was something along the following lines:

Well look, [] I experienced a bitterness problem in my cellars before that, then I took samples to them [the IWBT] to test and it appeared that there were quite a lot of bacteria in the wine, lactic acid bacteria, which could have caused the decay. Then I said to them if they want ... if they need people, you know, [] farms that they want to do a project on, they could do it with us at any time [] and then Maret du Toit and one of her assistants visited the cellars before the harvest and the project began. (Winemaker B, interview (translated from Afrikaans))

The role of the winemakers as project participants was largely passive, i.e. they simply provided access to the organic materials for analysis (samples of grapes, juice and wines). However, throughout the project there was active communication between the winemakers and Ms Krieling, implying that some knowledge transfer occurred between the postgraduate student and the winemakers. This is discussed in Section 3.4, focussing on the project participating winemakers as the first (industry) users of the project results.

The postgraduate student as primary research worker

Ms Krieling obtained her BSc in microbiology and biochemistry at the University of Stellenbosch and, in 2001, enrolled for the honours programme in wine biotechnology at the IWBT. This brought her in contact with Dr du Toit, who also supervised her honours project. At completion of her honours, Dr du Toit presented Ms Krieling with topics for a master's thesis, and the role of LAB in bitterness in wines was chosen.

What were the main findings of Ms Krieling's investigation?

It was found that there are definite differences between the LAB ecology of Pinotage, Merlot and Cabernet Sauvignon. Cabernet Sauvignon had a higher LAB population, while Pinotage, a unique South African variety, had the most diverse population. The two most dominant species isolated were *Lb. plantarum* and *Pediococcus* spp., with *Pediococcus* spp. being isolated mostly from Pinotage. This is the first time that *Lb. plantarum*, *Lb. paracasei* and *Lb. pentosus* are reported to possess the ability to degrade glycerol. Interestingly, 62% of the GD-possessing strains were isolated from Pinotage. The study also reports the finding of possible antimicrobial activity of LAB against a range of Gram-positive and Gram-negative bacteria. The results suggest that this activity might be similar to that of reuterin, which is produced by *Lb. reuteri*. Further research needs to be done on the characterisation of the glycerol-degrading ability of the GD-possessing strains, and the specific products formed from glycerol have to be determined. In order to determine the ability of LAB to form acrolein, and thus assess their potential to cause bitterness, an analytical method for the detection of acrolein in wine has to be optimised.

Source: Krieling (2003), Chapter 3, p.54.

Nature of research work performed. The LAB component of the project involved a significant fieldwork component, for which Ms Krieling was responsible:

I physically went to the farms, five vineyards, or to five wine farms, and then I harvested grapes there. So I did the whole story from the start of the harvest, because I monitored it from the grapes, right through to the fermentation process. So for two years I went to the vineyards during harvest and then to the cellars as well [] to collect wine samples. (Shannon Krieling, interview 1 (translated from Afrikaans))

Once collected, these samples were analysed in the laboratory. The analytical component largely involved work on a molecular level.¹⁴ It focused on the isolation of the LAB that occur on Pinotage, Merlot and Cabernet Sauvignon grapes and in the fermentation process, as well as the identification of these LAB isolates. The end result was judged to be of high academic quality, because the degree was conferred with distinction. The fact that Ms Krieling successfully completed the research requirements for her MSc, however, does not mean that the LAB task of the project has also been fully completed.

No, I would say there definitely lies a [] finishing part ahead [] How can I put it, I basically did the foundation research about the role of lactic acid bacteria in bitterness, which produced good results but it will have to [] be assessed on a larger scale and then it must sort of [] these microbiological findings or results must be combined with analytical results [] Look, [] at that stage we couldn't, there wasn't an established analytical method to determine [] the bitterness levels, to detect that chemical component, acrolein, in wine or must or whatever. (Shannon Krieling, interview 1 (translated from Afrikaans))

¹⁴ The isolated bacteria were identified to the species level by means of colony PCR. Genomic DNA was also extracted and a DNA sequence analysis performed. These can all be regarded as molecular work (Shannon Krieling, interview 2).

Thus, the LAB research is now at a stage where integration is required with the output from another project task, namely the analytical method to measure bitterness (the task of Mr Minnaar at the ARC Infruitec-Nietvoorbij). Dr du Toit has indicated that an honours student will be used in 2004 to finish the LAB component of the project.

Ensuring research quality. Given that the research interaction between Dr du Toit and Ms Krieling largely resembled that of an experienced researcher and a researcher-in-training, mechanisms had to be in place to ensure research quality. This happened in the form of progress meetings and feedback sessions, which is standard practice at the IWBT. Students in any of the five research groups regularly meet with their project/group leader, as well as with other students in that group. There are also scheduled meetings between students and leaders of different research groups:

There was a system in place at the institute where every research group [] met at least once a week with the project leader and [] all the students. You then had to give feedback on your results or your problems or whatever you were experiencing, say, in the preceding week. And then you had to give your planning for the following week. So there definitely were sort of frequent sessions with her [Dr du Toit]. (Shannon Krieling, interview 1 (translated from Afrikaans))

During those weekly sessions it was only she [Dr du Toit], [] because she was the overarching supervisor. But then there was also, I think, where each group received, I think, something like twice a month, a turn to present [] We had such a weekly meeting where all students from the different groups met, and then someone had to present a project, his or her project up to that stage. Where everybody gave input [] about your results or your problems or whatever. (Shannon Krieling, interview 1 (translated from Afrikaans))

The research group, to which Ms Krieling belonged, also had a post-doctoral fellow (Dr Elize Muller-Patterton) who assisted in the laboratory and acted as substitute in the event of Dr du Toit not being available.

Codification of research findings. For each of the progress reports to WINETECH, in 2001 and 2002, Ms Krieling had to write a summary of her main results. Apart from these WINETECH progress reports, the MSc thesis of Ms Krieling was the other written output. According to Ms Krieling:

We had to write a full thesis with four chapters, where the third chapter usually comprised your research results. But the format of that chapter was [] in an article form. (Shannon Krieling, interview 1 (translated from Afrikaans))

The transition from thesis to article is thus facilitated through the practical arrangement of submitting a thesis chapter in article format. Hence, the main task involved in writing the scientific article is not one of restructuring and organisation of content, but one of shortening and complying to journal guidelines:

Yes, I am busy writing that. What I am busy doing [] To submit it now for publication there are all kinds of requirements, like the stuff must be ... your font or your line spacing must be double spacing and your figures must follow separately [] It [the thesis chapter] would need to be shortened. (Shannon Krieling, interview 1 (translated from Afrikaans))

This article, which is intended for a peer-reviewed scientific journal, will have three authors: Ms Krieling, Dr du Toit and Prof Pretorius. It only presents the LAB results and will not incorporate insights from the other two legs of the bigger project. It is a compact version of the thesis chapter.

3.4 Mode of knowledge utilisation

The knowledge utilisation aspects of the project cannot be seen in isolation to the modes of knowledge dissemination. Hence, when looking at the ways in which, for instance, the project participating winemakers are using the results of the LAB investigation, we will also consider the various routes of knowledge transfer.

Project participating winemakers as first industry users

The research findings that the project participating winemakers received were not those of the total project but only the findings on the LAB side of activities. Although the latter covers the core of LAB findings, it does not represent the complete LAB investigation. Ms Krieling's research mainly looked at the isolation and identification of LAB that could play a role in bitter wines. These were also the results that she disseminated to the winemakers.

Routes of knowledge transfer. The first route of dissemination was Ms Krieling's face-to-face interactions with the project participating winemakers. This happened as part of the normal course of the research project. When Ms Krieling collected the samples from the cellars and vineyards, it provided an opportunity for questioning and feedback. In Ms Krieling's words:

Yes, it usually was a question of okay, we must [] I told them [the winemakers], okay, the purpose of the monster that I had collected at that stage, and then I gave them a verbal update about [] whether I obtained any interesting results at that stage or made an observation [] because I also performed microbiological or lactic acid bacteria readings. Then each time I gave them the readings because it indicated to them whether or not they might have decay. (Shannon Krieling, interview 1 (translated from Afrikaans))

The sometimes rather extensive communication between the project participating winemakers and the postgraduate student can also be seen in the following quote from one of the winemakers:

Yes, we often talked about it. She knew a lot about it so she could always give me some information and, you know, tell me how the tests were going and so on [] Shannon [Krieling] kept me up to date the whole time [] More verbally, yes. (Winemaker B, interview (translated from Afrikaans))

The second route via which the results were distributed to the project participating winemakers, was by Ms Krieling sending them a copy of the results chapter of her thesis. None of the three winemakers interviewed had a problem with the format or layout of the thesis chapter, and stated that things were intelligible enough to extract the main trends. The winemakers interviewed had also distributed the chapter 'in-house', i.e. to fellow- and assistant-winemakers on the estate.

A third route of knowledge transfer was by the winemakers' presence at the 2002 annual meeting of SASEV. Ms Krieling presented the findings of her LAB investigation at the meeting, which gave the winemakers an opportunity to hear her 'talk to the findings'. This elicited a series of questions from especially two of the project participating winemakers, who, as it appeared, wanted information about the practical implications of the study:

[] at the [SASEV] conference, [Winemaker B], he and I and basically [Winemaker C], they were basically the two people who had the most follow-up questions. What was going to happen next and what they could do, given the results and so on. (Shannon Krieling, interview 1 (translated from Afrikaans))

A fourth route of knowledge transfer did not materialise. The project participating winemakers were invited to the oral defence of Ms Krieling's MSc thesis at the IWBT. None could however attend because the defence coincided with vintage time (harvesting), normally the busiest time of the year on any wine estate.

Expectation of winemakers. The project participating winemakers saw the study as a potential source of information about the origin of bitterness in Pinotage wines. More specifically, they needed the information to get to the root of the bitterness problem in their own cellars. In other words, they wanted the information for problem solving:

Well, we hoped that we would [] get a bit more information about [] whether we might be doing something wrong, you know, whether [] specifically whether the grapes, you know, the Pinotage, that Pinotage grapes were more inclined to [produce bitterness] because of the, you know, the acrolein that forms in Pinotage wines. So [] we specifically wanted to know more about the Pinotage because our other wines did not become bitter in the cellars. Only the Pinotage wines did. (Winemaker B, interview (translated from Afrikaans))

[] primarily what the cause of the problem was, because no one exactly knew what the cause was and, I mean, there can be many causes and I just

wanted more information about that [] you cannot solve it if you don't know what causes it. (Winemaker C, interview (translated from Afrikaans))

Dr du Toit also points to the problem-solving expectation of the participating winemakers when she says that:

[The winemakers] just always wanted to know, has the problem been solved yet. (Maret du Toit, interview (translated from Afrikaans))

The focus of Ms Krieling's investigation, however, was not so much on problem solving, as it was on the clarification of the role of LAB in the formation of bitterness in wines. This might not have met the expectations of the winemakers, who wanted a solution. In Ms Krieling's experience:

I think they had greater expectations [] they expected a solution, whereas this was more [] it was not the purpose of the project to provide a solution but rather to see what we could deduce from the lactic acid bacteria population that is found on our grapes and in the wines. (Shannon Krieling, interview 1 (translated from Afrikaans))

If no solution was formulated, or intended, what did the winemakers gain from the investigation? Differently put, can they use the findings of the LAB investigation? We will address this separately for the three winemakers interviewed.

Research uptake: Winemaker A. According to Winemaker A, the findings of the investigation created an increased awareness about the role of bacterial activity in wine spoilage. This resulted in him taking a more preventative approach to his winemaking:

[] there is bacterial activity and it's greater in Pinotage than in any of the other grapes. So the danger is there. So we are more aware of bacterial [] of potential bacterial decay on Pinotage. And we acted more preventatively [] especially this year as far as bacterial decay is concerned. (Winemaker A, interview (translated from Afrikaans))

The prevention entails monitoring the bacterial levels during the different stages of winemaking. What he emphasised, though, is that it would be unrealistic to introduce any changes to his winemaking practice based on the research findings. One gets the impression that he sees the findings as just one piece of a bigger puzzle. In his own words:

So it was interesting, you understand, and I know more or less [] bacterial decay is a major cause [] but it is not the only cause of bitterness in wine. (Winemaker A, interview (translated from Afrikaans))

His uptake of the research findings is largely on a cognitive level – the findings are regarded as 'interesting', something that should be taken into account in winemaking. Moreover, the winemaker seems cautious about placing too much emphasis on the findings. Three explanations for the cautiousness emerged from the interview. The first relates to the winemaker's understanding and interpretation of the research questions and actual findings.

To his mind, there were disappointments:

As far as I remember, [the IWBT project team] said that there are certain bacteria, certain genera, [] species that cause bitterness in Pinotage. And I don't think that in the investigation [] it was that prominent. The other thing is your levels of bacteria varied a lot; you didn't always get constant levels of bacteria in certain areas, for certain sulphur levels and things like that. So the incidence and activity of bacteria was a bit unpredictable. And I also think the correlation between bacteria and bitterness wasn't as strong as we expected it to be. (Winemaker A, interview (translated from Afrikaans))

The second explanation relates to the winemaker's view of the investigation as a small piece of a bigger puzzle. He clearly supports a holistic approach to winemaking, when he warns against prioritising a single research finding:

[] but there are lots of variables in the wine preparation process. You cannot single out one variable and say that it makes a radical change in your wine. You need to consider the whole process and all the different variables before making a decision. (Winemaker A, interview (translated from Afrikaans))

The third explanation relates to the winemaker's perception of research in general, particularly the changing and open-ended nature thereof, and changes in its application in practice. He is almost sceptical when remarking that:

[] research changes. What I learned at Stellenbosch [the university] ten years ago, is not even applicable today any more. You know there is, for example, there are [] nitrogen [] models that they taught us ten years ago at Stellenbosch. The students who finished five years ago work with a different model. A phosphorus model of nitrogen is not applicable today. So [] science changes and one article, one set of research results, unfortunately, isn't infallible. One reads it and it's very interesting but I don't think [] that a single research investigation can [] turn everything around. You take note, you take note thereof. (Winemaker A, interview (translated from Afrikaans))

This again confirms that the winemaker took cognisance of the research findings but without any implementation or change in practice. The winemaker's hesitance to introduce changes should also be seen against the fact that he, as he put it, has wine worth millions of Rands in the cellar. When asked what would motivate him to introduce a change in practice, his answer was straightforward: personal experience only.

Research uptake: Winemaker B. Winemaker B, in contrast to Winemaker A, introduced some change in practice based on the research findings. He remembered the research findings to be along the following lines:

They more or less, you know, basically said more about [] the type of bacteria etcetera, which cause bitterness. How it happens. And obviously that you can now work with low pHs, and that your wine has to be very sterile. They definitely made recommendations that, if your wine has a high bacterial reading after fermentation, you do a sterile filtering of the wine. (Winemaker B, interview (translated from Afrikaans))

Already in his account of the findings, there is reference to practical utility. Winemaker B was also one of two winemakers who, at the annual SASEV meeting in 2002, questioned Ms Krieling on the practical aspects of the research findings. The practices he eventually adopted were the lowering of pH's by adding tartaric acid, and the sterile filtering of wine.

However, upon probing, it turned out that the winemaker already knew about the beneficial aspects of these two practices, *before* the results of the LAB investigation were communicated. It was mainly because of his own reading of the available literature, which he did both prior to and at the time of the investigation. The intensive reading he ascribed to the fact that he was experiencing a bitterness problem and needed an answer. Therefore the changes in practice that he introduced were not exclusively informed by the LAB investigation:

I think that what they said to us I have also read in the literature beforehand. I think it is commonly known that your wine should be relatively sterile in the barrels. [] I basically read through the literature and through what I read I realised you have to [] that your pHs are very important and that you have to add [tartaric] acid and that it can help tremendously to prevent bacterial problems. (Winemaker B, interview (translated from Afrikaans))

Winemaker B thus integrated the research findings with knowledge from other sources. Mainly, the research findings confirmed what he already suspected to be a solution to the problem of bitterness in wines. By implementing the solution, the bitterness problem was solved. However, the change in practice has created a new problem:

It [the bitterness problem] was solved, yes, since we started working in a sterile [] or did sterile wine filtering, it has largely been or completely solved. But one problem that still remains is that we have to add to our wines tartaric acid to lower the pHs. And it's a problem because we don't really want to add that much tartaric acid. As I said, the wine tastes hard and aggressive. (Winemaker B, interview (translated from Afrikaans))

Thus, in this winemaker's case, there exists a tension between potential bitterness in wines (if one increases the dosages of tartaric acid to avoid a hard and aggressive taste) and producing better-tasting wines (if one lowers the addition of tartaric acid but with the risk of wines that will become bitter in the cellar due to higher levels of pH's). This confirms what Winemaker A has said: winemaking is a complex and integrated process and more than one variable needs to be considered.

Research uptake: Winemaker C. Winemaker C regards some of the findings as 'interesting new facts' but only uses them in a preventive sense. According to him, the results only pointed to potential causes of bitterness in Pinotage wines. He still doesn't know what caused the wines in his cellar to have become bitter in the first place.

[] they did research and told me what may cause bitterness. In my opinion that's primarily what they did. So now I try to act preventatively so that it doesn't happen in the wine [] [The study] only gave me an indication of the kinds of bacteria you get and how different pHs can influence these, and things like that [] It still hasn't provided answers to bitterness. (Winemaker C, interview (translated from Afrikaans))

He also underscores the multivariate nature of problems experienced in the making of wine. He feels that one should be cautious to implicate bacteriological activity as the main cause of bitterness. He himself consulted the results of other research, particularly those by Ms Adele Louw from ARC Infruitec-Nietvoorbij. Based on these readings, he tried to merge the bits and pieces to form a coherent picture, in order to inform practical decision-making:

The thing is there isn't, there isn't enough for me because I don't think it's a single problem. It's a facet that can cause bitterness, it's a facet that can cause acrolein and acrolein can give bitterness. It's not to say that the problems with bitterness that we experienced in the past, in 1996, 97, 98, it's not to say that those things were only bacteriological in nature. (Winemaker C, interview (translated from Afrikaans))

... I look at the stuff that [Dr du Toit] did, I look at the stuff that Adele [Louw] did [] You look at the whole picture and then you draw conclusions and because of those conclusions you do certain things in the future. You might look more specifically at your pHs, you look more specifically at your ways of using sulphur and things like that to prevent possible decay situations [] I use all these results to make up my own mind and to help me decide what to do. (Winemaker C, interview (translated from Afrikaans))

Winemaker C also informally communicated the LAB results to other winemakers, mostly at meetings of the Pinotage Association, of which he is a member. In the next section, we will also look at the role of the Pinotage Association in knowledge dissemination, when we discuss the routes of knowledge transfer to project non-participating winemakers.

Project non-participating winemakers as eventual industry users

The extent to which the results of the LAB investigation have in fact reached the project non-participating winemakers, is at this stage mere speculation. At best, we can only discuss the real and potential routes of knowledge transfer to these industry users. The first route has already happened. It was via the 2002 annual meeting of SASEV, where Ms Krieling presented the results of her investigation. One of the project participating winemakers that we interviewed, stated that the overwhelming majority of winemakers

are members of SASEV and therefore would have been at that meeting. Moreover, SASEV members usually receive copies of discussions from SASEV meetings:

Look, most of these guys are members of SASEV. I'm not a member. But if you are a member, as I say, you know 99% of all winemakers are. So whether you go the conference or not you anyway get a copy of everything that was discussed at the seminar. And then it's relatively comprehensive articles about the research. (Winemaker A, interview (translated from Afrikaans))

The document that Winemaker A refers to is the collection of abstracts of posters and papers presented at a SASEV meeting, and which is circulated among conference attendees and SASEV members. An abstract of Ms Krieling's research was also circulated in this way. Moreover, even though a winemaker does not belong to SASEV, he or she still seems to get a copy – probably because of close relations among winemakers.

Moreover, Dr du Toit's project feedback at a WINETECH meeting (end of 2003) has created one spin-off. A representative from Anchor Biotechnologies, who also attended the meeting, has invited Dr du Toit to present the research at their **technical forum**. The representative was Ms Karien Lourens (see Sections 5.3 and 5.4), and the reason for her presence at the WINETECH forum was because of Anchor's and WINETECH's joint funding of some projects. Thus, in November 2003, Dr du Toit presented the results of the LAB research at Anchor Biotechnologies. Who normally attend these forums? According to Ms Lourens:

It is attended every year by about a hundred or so winemakers and researchers. We invite everyone. [From a contact list of about 450 winemakers and researchers.] It's 'first come first serve'. It is free. It is a kind of favour that we do for the wine industry. It's a half-day event and we usually give four lectures and a tea and then lunch. (Karien Lourens, interview (translated from Afrikaans))

Not only estate winemakers attended the Anchor Biotechnology forum, but also winemakers from the cooperative and independent cellars, and winemakers from the producing wholesalers.

The oral defence of the postgraduate student's MSc thesis was another route of knowledge transfer to winemakers, although only to winemakers who are employed by the major producing wholesalers, such as Distell and KWV, and by the ARC Infruitec-Nietvoorbij. According to Dr du Toit:

[The MSc defence] is advertised in WINETECH, Nietvoorbij, Distell, the KWV. From the company there was [] definitely from Nietvoorbij and Distell there were people who attended. (Maret du Toit, interview (translated from Afrikaans))

Once the popular article in **Wynboer Tegnies / Technical** materialises, it will definitely help in transferring the project results to the project non-participating winemakers. The role of **Wynboer Tegnies / Technical** (in **WineLand**) in knowledge transfer is a prominent one. Winemaker B regarded the magazine as his main source of research

information in the wine industry. Winemaker A confirmed this but added that he only reads relevant articles.

Another route of knowledge transfer to project non-participating winemakers is via the Pinotage Association. Pinotage is the grape variety that was prominent in the LAB study. Since the majority of winemakers who use Pinotage grapes are members of the association, one could expect the Pinotage Association to be disseminating the findings in one way or the other to its members. According to the association's website:

The association is very serious about communicating the knowledge its members have gained. To this end, it holds regular workshops on the growing of Pinotage grapes and the making of Pinotage wines. (<http://www.pinotage.co.za/>)

However, an interview with Mr Pierre Loubser, the manager of the Pinotage Association, revealed that the results of the study have not officially reached the association, simply because the project is not completed yet. On the other hand, the association's main source of research information is Dr Johann Marais, a specialist scientist at the ARC Infruitec-Nietvoorbij. Since Dr Marais' institution is also involved in the research on bitterness, the interim results have already been communicated informally to the Association. Dr Marais is also responsible for identifying researchers to be invited for presentations at the Association's annual meetings in November. Dr du Toit¹⁵ previously spoke at such a meeting but not on the issue of bitterness in Pinotage. About a third of the Association's 180 members attend these annual meetings.

Moreover, the newsletter of the Association does not appear to be a major dissemination channel for research results, simply because Mr Loubser is the only full-time employee of the Association and sees himself as a clerk, not as a journalist. Still, the newsletter and e-mail communications of the Association play a valuable role in a different sense. Mr Loubser explains:

*[] that which is going to get published in an edition of **WynLand** we usually know a month or so in advance and on the basis of this we send out a newsletter, or whatever it may be, to our members and we alert them to what will be published. (Pierre Loubser, interview (translated from Afrikaans))*

Lastly, and directly related to our investigation, the Pinotage Association meetings also provide an opportunity for the informal communication and discussion of research findings among Pinotage producers. Winemaker C, for instance, communicated the results he got via his participation in the project to fellow winemakers at one of the meetings:

[] one constantly talks at Pinotage Association meetings, where people ask you what you think, I mean, then you make use of some of the experience that you gained. Obviously you will convey it to them as well. You know, to some extent, in an informal way, some of the information has been conveyed. (Winemaker C, interview (translated from Afrikaans))

¹⁵ Dr du Toit received associate membership of the Pinotage Association because of her interest in Pinotage wines. According to Mr Pierre Loubser, the membership is not directly related to the research on bitterness in Pinotage.

The majority of winemakers in South Africa studied at the University of Stellenbosch or at the Elsenburg College of Agriculture. These winemakers seem to maintain close relations with the lecturers and research staff at their *alma mater* institutions. Dr du Toit, for instance, mentions that winemakers often approach her for advice on bacterial issues, or to do bacterial analyses. Winemakers regard these training institutions as important sources of new and advanced knowledge:

It's conversations as well, having conversations with people "in-the-know", so we keep contact with Wine Biotech [IWB] and with Elsenburg. Mr X [name omitted] who was my lecturer at Stellenbosch, is now at Elsenburg. So I have a lot of contact with Elsenburg and Stellenbosch [the university]. That's how I stay on top, more that. [] I also have a lot of contact with Wine Biotech [IWB], as I say, I keep contact with them, because [] it's the best way to maintain contact and to stay in touch with technology. (Winemaker A, interview (translated from Afrikaans))

Another route for knowledge transfer to project non-participating winemakers is through the training of the next generation of winemakers. This particularly applies to those aspirant winemakers who are currently training at the Department of Viticulture and Oenology at the University of Stellenbosch. As Dr du Toit explains:

[] because I lecture wine microbiology as one of my subjects on the oenology side, and [because] a part of that class is about wine spoilage, I definitely conveyed the research results as it came through. (Maret du Toit, interview (translated from Afrikaans))

Dr du Toit incorporated the results of the study in her teaching to both undergraduate and postgraduate students. This happened in the form of PowerPoint slides that she took from her collection of project presentations.

Informing a scientific audience

Obviously the LAB research, being academic in nature, is also targeted at a scientific audience. Apart from the scientific article that is being finalised and the presentation at the 2002 SASEV meeting, parts of the investigation were also presented at a meeting of the South African Society for Microbiology. This happened in 2002 in Bloemfontein, in the form of a poster presentation by Ms Krieling. There were also two international presentations, which Dr du Toit was responsible for.

Other

Ms Krieling uses some of the skills acquired on the project in her new position as laboratory technician at Distell's branch in Worcester. She manages the laboratory at Distell and although not involved in red wines anymore but in brandy and distilling, she still draws upon her project experiences to assist in her daily tasks:

Yes, I would say that it's not directly [related to] the project, but the whole idea of doing research and [] interpreting stuff, the interpretation of data and drawing conclusions from it. And just to organise stuff, how can I put it, the projects. We have quite a few things like mini-projects running at present. (Shannon Krieling, interview 1 (translated from Afrikaans))

3.5 Comments about this project

The LAB research was conducted within the context of two objectives:

- 1) to produce good quality research for a postgraduate degree, and
- 2) to generate results that would be useful to industry, specifically with regard to the issue of bitterness in wines.

However, the academic piece of work – with a single focus on LAB – did not meet the expectation of the project-participating winemakers. For instance, the participating winemakers wanted information about why some of the wines in their cellars had become bitter. Instead they received a set of results that indicated that LAB potentially could play a role in the formation of bitterness. To add to it, no direct correlation could be made between LAB and bitterness. The results, however, formed part of a MSc degree that was conferred with distinction. Moreover, the winemakers knew from experience that a single intervention has the potential to catalyse a range of changes because winemaking is a complicated, multi-faceted process. However, the project feedback highlighted one facet: bacterial activity.

Admittedly, the LAB research component does not comprise the total picture. It forms part of a bigger project. This project, in its totality, will be ‘saving the day’ for the winemakers. Not only does it consider more than one variable but also have standard analytic tools as an output. As a result, bitterness will be more accurately measured, which will aid the understanding of its causes. Although the bigger project moves beyond bacterial activity as a potential cause of bitterness, the question still remains: how will the results be disseminated to the wine industry – as a series of separate articles or as one integrated article?

One lesson to be taken from this project is the following: when there are horizontal research-worker interactions, involving collaboration with a non-university organisation on a multi-faceted issue, it could help to transform the academically orientated results of the university sector into something useful for industry.

To what extent do the other two forms of interaction (vertical research worker interactions and research worker-user interactions) contribute to potential utilisation? In the case of vertical interactions, there appears to be no direct link to industry utility. The outcome is a scholarly one: research capacity building and quality. In this regard the research group structure at the IWBT needs to be highlighted. It plays a central role in the supervision and development of postgraduate students as researchers. Not only does it help students to develop critical planning and presentation skills, but it also provides an opportunity for peer review and support.

The researcher worker-user interactions are a way of knowledge dissemination, and hence could impact on industry utilisation. Because of the very nature of verbal communication, it is not unreasonable to assume that the knowledge communicated to the winemakers at times also extended the boundaries of the LAB investigation. In informal verbal communication, one utilises an arsenal of knowledge, both codified and tacit, which, in this case, might have included things such as, the problems experienced by other winemakers, as well Ms Krieling’s and the winemakers’ own insights and perceived

linkages. A further point to be made is that through these individual feedback and discussion sessions, the winemakers most probably received knowledge that was better tailored to their own wine estate and cellar conditions.

4 Project 2: The occurrence of malolactic fermentation (MLF) in rebate wine and its influence on brandy quality

4.1 Project history

Low dosages of sulphur dioxide (SO₂), together with factors such as high temperatures and low concentrations of alcohol, create favourable conditions for LAB – which naturally grows on grapes – to flourish in wine. LAB is responsible for malolactic fermentation (MLF), which is often desirable in red wine as it decreases acidity, produces flavour compounds and increases microbiological stability.

But to what extent is MLF also desirable in rebate wine, i.e. the base wine from which brandy is made? Moreover, does MLF even occur in rebate wine? These two questions interested Prof Lambrechts in 1996 when he was working as a senior researcher at the IWBT. The IWBT, at that time, had been in existence for less than a year and Prof Lambrechts was building his research group when the questions struck him as interesting enough for a research topic. Conversations with people in the spirits industry could not provide an answer to the occurrence of MLF in rebate wine. However, Prof Lambrechts suspected that spontaneous MLF in fact occurs in rebate wine, given that rebate wine contains almost no SO₂ to inhibit the growth of LAB – international legislation determines that the total level of SO₂ in rebate wine must not exceed 20 milligram per litre. A research proposal was therefore formulated to empirically confirm his suspicion, as well as to look at the influence of MLF on brandy quality, and the kinds of LAB involved in MLF and negative brandy quality.

The research proposal was submitted to WINETECH, and assessed, approved and monitored by the Brandy and Distilling Committee (i.e. a specialist subcommittee of the Oenology Committee). The project could also have been submitted to the Microbiology Committee, but the Brandy and Distilling Committee were selected because it had fewer projects than the Microbiology one. The project formally started in 1997 and ended in 2002.

During the first year of the project (1997) Dr du Toit was not yet part of the IWBT but completing her PhD under the supervision of Prof Dicks at the Department of Microbiology, University of Stellenbosch. She only joined the IWBT in 1998 as a postdoctoral fellow and was instantly taken on board the project because of her expertise in LAB. In 2001, Prof Lambrechts left the IWBT for the position of group research manager with Distell¹⁶, one of the leading producing wholesalers in the South African wines and spirits industry. His permanent position as senior lecturer in the Department of

¹⁶ Distell is both a producer and marketer of wines and spirits. It markets approximately 15 million cases of wine, over 40 per cent of all spirits and over 50 per cent of the flavoured alcoholic beverages sold in Southern Africa, employs over 4000 people and has an annual turnover well in excess of \$US700 million. The company was formed in 2000, through the merger of Stellenbosch Farmers' Winery and Distillers Corporation, to become South Africa's premier producer and marketer of wines and spirits (<http://www.distell.co.za/>).

Viticulture and Oenology became vacant and Dr du Toit was appointed. She also took over the leadership of the project. Prof Lambrechts¹⁷, however, remained a part-time associated professor at the IWBT, and for that reason had close ties with the project and the postgraduate student on the project. As we will shortly see, the rebate wine producers who participated in the project all delivered to Distell and provided another reason for Prof Lambrechts' continued involvement with the project.

4.2 Key project descriptors

Project objectives

The purpose of the study, as conceptualised by Prof Lambrechts, was to determine:

[] the extent to which lactic acid bacteria (LAB) occurred in brandy base wines, their ability to catalyse the malolactic fermentation (MLF) and the effect of MLF on the quality of the base wine and the brandy distillate. (WINETECH progress report 2002a)

Size and composition of team

Four researchers worked on the project and each experienced a change in position during the project duration. First, Prof Lambrechts, who started as project leader, eventually became the main industry partner. Second, Dr du Toit, who started as a post-doctoral fellow on the LAB side of the project, ended up as the project leader. A postgraduate student, Mr Heinrich du Plessis, who began working on the project in his honours year, ended up doing his masters thesis on the topic of LAB and brandy quality. Another postgraduate student, Dr Caroline Snyman¹⁸, conducted part of her masters on the topic of MLF before completing that degree as well as her PhD on a closely related topic. During her PhD studies, Dr Snyman also found employment with Distell and became an industry partner on the project.

Sources of funding

It is a WINETECH funded project, which generated THRIP money. In addition, the postgraduate student who performed the lion's share of the work, Mr du Plessis, received money from the NRF in the form of a postgraduate bursary.

Project outputs

This project has generated a substantial number of outputs. Apart from two scientific articles in international peer-reviewed journals, there was one article in **Wynboer Tegnies / Technical**, and six presentations at international and national conferences. There was also Mr du Plessis' MSc thesis. The details appear in the appendix.

¹⁷ More about Prof Lambrechts: Since 2001 he is also a winner of the highly prestigious President's Award by the NRF for his research into microorganisms and their role in wine and brandy aroma.

¹⁸ Dr Snyman's maiden name is Steger. This name also appears in the list of project outputs in the appendix.

What were the main project findings?

The findings indicated that LAB occurs in high numbers in juice and rebate wine and are able to conduct MLF. In the majority of instances *O. oeni* was the species responsible for the occurrence of spontaneous MLF, but *Lb. brevis*, *Lb. hilgardii*, *Lb. paracasei* and *Lb. vermiforme* were also found in rebate wines. There is a direct correlation between the presence of Lactobacillus species and the reduction in quality of the rebate wine and distillate. It was also found that spontaneous MLF occurs in South African rebate wine and that this definitely has an influence on the sensorial quality of the rebate wine and the brandy distillate.

Source: <http://www.wynboer.co.za/recentarticles/0404impact.php3>

4.3 Mode of knowledge production

In reflecting upon the knowledge production aspects of the project, two issues immediately come to the fore. The first is Distell's close association with the project. The second is that the project served as a vehicle for the development of a postgraduate student (who was first an honours and then a masters student) as a competent research worker. These issues will be discussed in the following subsections.

University–industry research interaction

The wine and spirits industries that participated in the project, specifically those involved in the production of brandy, were of two kinds. First, there was Distell, a leading South African alcoholic beverage company with commercial distilling facilities, and second, five producers of rebate wine who supplied these base wines to Distell for distillation. The project team interacted with both industry groupings, but the interaction with Distell was the most prominent. Distell was involved from the start, by helping to 'fine-tune' the project proposal and acting as a soundboard:

[] with Distell [at that stage Distillers Corporation] we talked a few, well, several times and, yes, they also did for example, they came with proposals and said yes, okay, this is how the season will work and they would like to suggest this and this advice [] so yes, there were inputs from their side. (Marius Lambrechts, interview (translated from Afrikaans))

The 'they' to whom Prof Lambrechts refers, appear to be Mr Erhard Wolf and Mr Johan Venter, today respectively the manager of strategic information and supply, and group general manager (spirits) at Distell. Dr Snyman, who worked on the project in 1998, and who since 2000 has been the technical manager of the spirits division at Distell, highlights the role of these individuals in the accomplishment of the project. One of them helped to 'illustrate' to the team the strong possibility of the occurrence of MLF in rebate wine at one of the company's distilling sites:

We built a good relationship with the then Distillers Corporation, with Erhard Wolf and Johan Venter ... It's actually via Johan Venter that we got an opportunity to see that MLF could have an effect because he took us to one of the distillers in Worcester to see... and there we discovered that the wine actually stands in the sun for up to ten days before being distilled, without any sulphur and alcohol cooling. So it's ideal MLF terrain. (Caroline Snyman, interview (translated from Afrikaans))

Thus, it was largely the prevailing conditions at Distell that informed the project proposal, although Prof Lambrechts also held informal discussions with other distilling companies prior to the proposal.

Once WINETECH had approved the project proposal, Distell provided the names of five rebate winemakers to incorporate in the study. These winemakers, as said, all supplied to Distell. When the project began, their role was largely a passive one. They simply allowed the project team access to their cellars to collect samples of grape juice and rebate wine for laboratory experiments. This happened over a period of three years. Towards the end, the project team also conducted a few experiments at the commercial cellars, which entailed more interaction with the rebate winemakers:

Initially [] it was mostly about getting the stuff [samples] from them [rebate winemakers]. Later we did one or two experiments on large scale at the cellars, so there was liaison where we actually said, okay, they must add, say, this to the wine making process, or so, yes. (Marius Lambrechts, interview (translated from Afrikaans))

The interaction between the project team and rebate winemakers can be regarded as one potential route of knowledge transfer. We will look into this in Section 4.4.2. Another point to be made is that at the time of the commercial scale trials – both at the cellars and at Distell – Prof Lambrechts was already in his current position and, for that reason, the dedicated person to arrange the trials with Distell. As the postgraduate student, Mr Du Plessis, remarks:

Marius Lambrechts, who is now at Distell, also helped that we could do the results on commercial scale. I think the last year [] this stuff was also done on commercial scale [] We first, say, did it all on smaller scale, on an experimental level, but the commercial stuff was arranged by [] Prof Marius Lambrechts with Distell so that they could do it on commercial level. (Heinrich du Plessis, interview 1 (translated from Afrikaans))

Moreover, through Prof Lambrechts' employment at Distell, one could argue that there has been a shift in the role of Distell on the project. The shift was from a close 'background partner' (i.e. a general source of information, the gatekeeper to rebate winemakers, and a provider of infrastructure) to an actual producer of knowledge. Being a research manager with Distell, Prof Lambrechts remained an active member of the knowledge producing project team:

Yes, I stayed involved [with the project] to the end. Yes [] it was part of the team because I [] the postgraduate students who were involved, I was also still involved with [] Most of the work when she [Dr du Toit] joined was already at a advanced stage, so for that reason we decided that it would be better if a person who is full-time at university move in as the [project] head there. But I stayed connected until the end because of my involvement but also from a Distell point of view. (Marius Lambrechts, interview (translated from Afrikaans))

Thus, a key project member was wearing a double hat towards completion of the project: that of both knowledge producer and first industry user. Given this, as well as the close

involvement and interest of Distell in the project overall, two questions emerge. The first is how does Distell utilise the findings of the project, given that it had the benefit of an insider perspective? The second question relates to the WINETECH claim that its funded projects benefit the whole industry, not only one stakeholder. Thus, to what extent is the knowledge also available to the broader wine and spirits industry in South Africa? What are the modes of dissemination? We will address these issues in Section 4.4. Before doing so, we will first give an account of the research process and the activities involved.

A retrospective account of the research process

This account of the research process is largely informed by the views of Mr du Plessis and Dr Snyman, who were both postgraduate students at the onset of the project. Today Mr du Plessis is a senior researcher at the ARC Infruitec-Nietvoorbij, at their Post Harvest and Wine Technology Division (Microbiology). Dr Snyman, as indicated, is employed by Distell.

Dr Snyman embarked on her MSc in 1997, on the topic of the breeding of wine yeasts with improved brandy aroma, under the supervision of Prof Lambrechts. It was during this first year of her MSc that it became clear that MLF could have an impact on brandy quality. For that reason, an honours student, Mr du Plessis, was appointed in 1998 to specifically look at the occurrence of MLF in rebate wine. According to Mr du Plessis, the topic was not his first choice although it stimulated his interest:

I think that when we started in 1998, in my Honours year, there was a lot of projects that [] let's say very applied research that basically gives you direct results [] Unfortunately, only three projects were in the wine industry. It was the MLF-project and then [] the distribution of wild yeasts, and then [] I think there was an alcoholic beverage project, but the thing is that everyone was eager for the other two projects. The MLF-project was [] the only one that was left over. (Heinrich du Plessis, interview 1 (translated from Afrikaans))

What attracted him to the project was its perceived applied nature. He compares it directly to more molecular, i.e. fundamental, kind of research work. In his perception, applied research gives one the satisfaction of having the attention and immediate interest of the people in the industry:

Yes, I wanted to do the research or one of the reasons that I wanted to do the research, is basically to give something back. It is much easier to [have] results that you can interpret and then convey to people than molecular type [] [than] only doing research that you know is about the wider spectrum [] that will help people but which isn't always that relevant for the interest. (Heinrich du Plessis, interview 1 (translated from Afrikaans))

However, this does not imply that Mr du Plessis' research did not involve molecular work at all. As he explains:

The molecular work primarily was the identification part of the bacteria and basic characterisation to see [] we basically used proteins to identify, which basically is molecular work []. (Heinrich du Plessis, interview 2 (translated from Afrikaans))

During Mr du Plessis' honours year, Dr Snyman finished her own masters and supervised Mr du Plessis in the laboratory. Mr du Plessis, however, was not the only honours student working on the project in 1998. Also another student left the project after completion of his honours. Nevertheless, the work involved was quite voluminous and Dr Snyman helped these two honours students in whatever ways she could:

It was a lot of donkey work, collecting samples and then results and so on [] I helped them quite a lot to do the data collection and analysis and the interpretation thereof. So in the first year I was quite involved with the project as well as with the writing of the reports. (Caroline Snyman, interview (translated from Afrikaans))

Dr du Toit joined the IWBT in 1998. Hence, the laboratory was a place of activity and interaction, and provided an opportunity for feedback and knowledge transfer. In fact, 1998 was the only year that all four individuals (Du Plessis, Du Toit, Lambrechts and Snyman) worked in the laboratory together:

[] and I must say that in that year it [the project guidance] worked quite well. Well, Maret [du Toit] [] and Marius [Lambrechts] were still in the laboratory full-time [] Marius was actually our supervisor and Maret was sort of the specialist on lactic acid, malolactic bacteria, because she did her PhD on that. So there was a lot of communication and, yes, contact. (Caroline Snyman, interview (translated from Afrikaans))

At the end of 1998, after graduation, Dr Snyman left the project to pursue studies in the field of chemical engineering, and in 2000 began a PhD in Wine Biotechnology on a related topic. Mr du Plessis, however, continued on the project and used the same topic as an opportunity for a further degree (MSc) in Wine Biotechnology:

[] his honours [that of Mr du Plessis] was basically to say, okay, we determined that MLF does play a role and that there is great variation in the population [] and then Maret [du Toit] and Marius [Lambrechts] decided, well, this is actually enough, that we could get another M out of it and that Heinrich could go on. And then his M focussed more on further results, that he basically had data for three years [1998, 1999 and 2000] and not just for one year; to then look at the specific isolation and identification of those bacteria. (Caroline Snyman, interview (translated from Afrikaans))

As part of Mr du Plessis' MSc thesis, the results of three seasons (i.e. three years) were monitored and compared. The reason was that the growth of LAB on grapes is partly affected by climate conditions, and if one includes only one season, there is always the possibility of picking a 'bad' season (one with little bacteria). The core of his MSc involved both laboratory and experimental cellar work. As Mr du Plessis explains:

There was [] a part where you had to go out and collect samples in the different regions, it obviously was in the Robertson, Worcester area. You physically had to go and collect the samples there. You had to drive, get the samples, bring it back to the cellar, make your wine, inoculate, isolate and identify the bacteria. It basically was laboratory work, and obviously the distillation was also partly laboratory work to get the final distillate or product. (Heinrich du Plessis, interview I (translated from Afrikaans))

The study, to some extent, developed beyond the project objectives as outlined in Section 4.2. Towards the end of the project, there were also two additional lines of research. First, to see what is the effect of lysozyme on brandy quality (lysozyme ‘kills’ LAB and therefore prevents spontaneous MLF) and second, to determine whether certain commercial MLF starter cultures have an effect on brandy quality that is different to that of spontaneous MLF. Whereas the lysozyme part formed part of Mr du Plessis’ thesis, the commercial MLF starter cultures part did not. Both these additional lines of research, apart from being studied in the laboratory, were also repeated on a commercial scale at Distell. All of these commercially orientated tasks again involved Dr Snyman because of her position as technical manager at Distell. In summary then, the only part of the project where Dr Snyman did not feature was in the identification of the LAB responsible for spontaneous MLF. This is also reflected in the omission of her name as co-author in one of the two scientific articles (see Section 4.2).

Mr du Plessis wrote both scientific articles, with inputs and suggestions from the other project contributors:¹⁹

[] I did all the work but Dr Maret en Prof Lambrechts obviously [] or, when I finished writing, they obviously checked it again and then of course Prof Pretorius and Prof Dicks also went through the articles and checked whether the content was scientifically acceptable and also the language. (Heinrich du Plessis, interview 1 (translated from Afrikaans))

He was also responsible for the popular article in **Wynboer Tegnies / Technical**, as well as the summaries for the WINETECH progress reports, as from the second year onwards. The final WINETECH report submitted was for 2002. The project, however, is not fully completed yet although WINETECH funding has officially ceased. Those commercial distillates that were produced in 2001 had been placed in wine barrels and stored at Distell until now. These still need to be analysed to study the effect of spontaneous MLF on brandy quality after three years of barrel maturation.

Overall, one could say that there was a large amount of independence expected from and granted to Mr du Plessis who worked as a researcher on the WINETECH funded project. But it did not happen without the necessary guidance and supervision. Dr du Toit summarises it best when she says that:

The student [] like in any tertiary environment, has a supervisor and co-supervisor and in the beginning the student must do a project presentation on the basis of what we initiated. At WINETECH he gets that background and then basically the student is in the laboratory and those goals that he has set for himself, which fall within the WINETECH goals, he has to execute. The students get frequent feedback in our laboratory meetings where the whole academic corps could give inputs, but have you thought about this or maybe this is a better idea, and then once a year they have to

¹⁹ Prof Pretorius is listed as a co-author of one article, as he provided the overall programme guidance. Prof Dicks, from the Department of Microbiology, is also a co-author because, in Mr du Plessis’ words: we used his laboratory to identify the bacteria and in regards to the protein profiles [] and then gave a lots of input regarding the bacteria, the identification of it, as well as the taxonomy of the bacteria, and then obviously to identify the bacteria that is found in all South African wine and [] he played a big role in that. (Heinrich du Plessis, interview 1 (translated from Afrikaans))

*submit a project report, which is then used to write the WINETECH reports.
(Maret du Toit, interview (translated from Afrikaans))*

4.4. Mode of knowledge utilisation

Distell is the main potential industry user of the project results. In this section we take a closer look at Distell's uptake of the results, as well as the extent to which the results were communicated to other brandy producing companies and project non-participating rebate winemakers. In addition, we will say something about the dissemination of findings to the scientific community.

Distell as main industry user

When discussing the role of Distell as a user of the project findings, it is helpful to distinguish between

- a) the uptake of the findings to inform internal strategic decision-making, and
- b) the uptake of the findings to inform the contracted suppliers of rebate wine.

The first refers to the evaluation of the project findings in terms of its implication for strategy and competitiveness, and the second to Distell's intermediary role.

Evaluating findings for strategy. Distell has a technical forum where all research findings with a direct bearing on the company's functioning and performance are regularly presented and discussed. The presenter normally is Prof Lambrechts or a quest speaker from the University of Stellenbosch:

We have a so-called technical forum in Distell. So any interesting industry results, which might be applicable to Distell, are presented three times a year at the technical forum [] Then it's also a forum to discuss about how we can possibly implement it, whether it is viable financially, if it will make an important difference. (Caroline Snyman, interview (translated from Afrikaans))

Once a decision is taken on the utility of the findings and the practical implications thereof for Distell, the research can be implemented. However, in the case of the project concerned, no final decision has been taken yet. The most probable uptake is for Distell to tell its suppliers of rebate wine that it should prevent spontaneous MLF at all costs. This potential uptake is a strong one because a recently completed PhD (under Prof Lambrechts' supervision) also showed the negative effect of spontaneous MLF on brandy quality. There is thus verification of findings.

Whereas the additional research that was conducted (the PhD study) confirms the quality-reductive property of spontaneous MLF, further research also shows that one should not eliminate MLF in rebate wine altogether. Differently put, only spontaneous MLF appears to have a negative influence on the quality of the brandy distillate, and spontaneous MLF is triggered by the LAB that naturally occur on the grapes. But MLF can also be catalysed by commercial LAB, and these are bred with the specific intention of contributing positively to the end product. Thus, the decision to be made is whether to tell the suppliers of rebate wine to inoculate with commercially available MLF starter cultures that are believed to make a positive contribution to brandy quality, or to instruct them to prevent all forms of MLF.

What further complicates things – or what makes it even more challenging – is that additional research indicates that more positive flavours could be obtained through inoculation with commercially available MLF starter cultures. This, in turn, could inform the development of new brandy styles that would give South Africa a competitive advantage on the world market. In Mr du Plessis' words:

I think they [IWB] conducted further research because we saw that even though spontaneous MLF was negative, we did see that if she [Dr du Toit] inoculated with specific bacteria the results changed [] It was one of the interesting things. I think they are busy doing research on, if you have commercially available bacteria, how to use it and I think their results show that more positive aromas [] can be obtained. So it is definitely a good thing for the South African brandy industry because at least it shows that there are possible options to change the brandy style to get something new or unique, which, in turn, can be used on the world market. (Heinrich du Plessis, interview 1 (translated from Afrikaans))

Distell is currently in the process of evaluating all the data available. Once a stance has been taken concerning the preference (or not) for spontaneous versus commercially started MLF in rebate wine, the producers of these wines will be informed accordingly:

The question [] is also whether maybe certain styles of your brandy, or let me put it this way, malolactic fermentation [MLF], could it also be important to some of your styles of brandy, or not at all? So it's now at this, I almost want to say, turning point where we [Distell] are, and if they are going to feel, no, this is too negative, malolactic fermentation, then they will make a decision and give it through to the producers who will then have to adapt. (Marius Lambrechts, interview (translated from Afrikaans))

Lastly, the study has also highlighted the plight of Distell to ensure that a solution is found to minimise the time between the production of the rebate wine (at the winemaker's cellar) and the distillation thereof (at Distell). The storage tanks at Distell are relatively old and without cooling systems; hence, once winemakers have delivered their wines to Distell, these are stored at high temperatures while waiting to be distilled. Such high temperatures, together with almost zero levels of SO₂, create favourable conditions for the occurrence of spontaneous MLF. Apart from prompting Distell to shorten the time between the cellar and the distiller, the results of the study will also be decisive in the construction of new storage tanks, should that ever become a reality:

The ideal solution would be if we could put in cooling systems in all our storage tanks. But in the distillation environment where the distillers are 30, 40 years old, the installation of cooling will be very expensive. But we know that if we have to build one again, if we have an opportunity to change things, then we definitely would consider cooling very, very strongly. (Caroline Snyman, interview (translated from Afrikaans))

Intermediary role. Distell communicated the findings of the project to its suppliers of rebate wine. This was done via their buyers of wine, who act as negotiators between the company and the wine suppliers. The role of the buyers is to negotiate the terms of the wine contracts, among which are the prices and volumes required. Distell gave the article

that Mr du Plessis wrote for **Wynboer Tegnies / Technical** to these wine purchasers who, in turn, discussed it with the rebate wine producers. The winemakers in question here are all Distell's suppliers of rebate wine, not only the five project participating ones.

Dr Snyman, however, underscores that the wine producers' uptake of the project findings is subordinate to that of Distell. The company must determine the guidelines and requirements as far MLF in rebate wine is concerned. This can only be done once Distell has taken a final decision on the matter.

The project participating rebate winemakers as industry users

There are three primary ways in which the results of the study were communicated to the project participating rebate winemakers. The first we have just mentioned, namely that of Distell disseminating the **Wynboer Tegnies / Technical** article to the winemakers via its wine purchasers. The second was through Mr du Plessis who, as indicated in Section 4.3, dealt with the winemakers when collecting the samples etc. This communication was mostly in the form of oral feedback:

There was contact [during the course of the project]. We basically did, I would say, not as regularly as we could have, but I basically tried to inform them at the end of each year about the progress, the results and so on. And then at the beginning of each year I contacted them again to say how we were progressing. So it was mostly verbally [] (Heinrich du Plessis, interview 1 (translated from Afrikaans))

Thirdly, Mr du Plessis also provided them with a written report at the closure of the project. He is however unsure about whether the winemakers understood the findings and the translation thereof into practice:

Whether they could interpret it [the report] is, of course, another question. I did not get any feedback from them. So I assume they understood what the results meant to them and how to apply what we had learned. (Heinrich du Plessis, interview 1 (translated from Afrikaans))

Nevertheless, according to Dr Snyman, the main uptake of the findings in the case of the rebate winemakers seems to be on a cognitive level. There is now a general awareness that MLF occurs in rebate wine, with consequences for quality. The winemakers now also know that they should not pressurise Distell to take in the rebate wine simply because they want more storage space in their cellars. They should rather wait until Distell has indicated its preparedness for distillation; otherwise the wine is going to be stored at the distillers at conditions that would catalyse spontaneous MLF.

If you look at five years ago [] everyone knew about MLF in wine, but no one actually thought about the linkage, that MLF could occur from general to rebate wine. So I think the biggest benefit or outcome of this project is the fact that our producers are now aware of the possibility of MLF in rebate wine and that it has an effect on our brandy styles. Definitely. (Caroline Snyman, interview (translated from Afrikaans))

[] actually what has happened is that they [the wine producers] are aware that [] whereas the storage space serves them good it affects the

quality and order of our products. So we can only carry a certain number of days' stock on the premises, we cannot carry it for longer because of the fact that it affects our quality. (Caroline Snyman, interview (translated from Afrikaans))

These cognitive uptakes not only apply to the five project participating winemakers but to all of Distell's suppliers of rebate wine.

Other brandy producing companies and rebate winemakers as industry users

An important consideration in the utilisation of the project research is the extent to which the results were also communicated to other brandy producing companies and the makers of rebate wine in general. Four (main) routes of dissemination can be distinguished. The first is the article in **Wynboer Tegnies / Technical**, which seems to be a major source of knowledge transfer in the wine industry. Secondly, Mr du Plessis presented the results of the research at the 2002 annual SASEV meeting. Thirdly, Mr du Plessis also had a defence of his MSc thesis and various role players in the wine and spirits industry were invited. Lastly, according to Mr du Plessis, members of the KWV, the other major brandy producing company in the country, was also included on the panel that conducted the sensory evaluation of the wines and distillates. Moreover, the KWV technical forum served as a vehicle for the dissemination of the research to this organisation. As Mr du Plessis explains:

[] at that time there still was a thing like a KWV-forum. We went quarterly and presented our different research results and [] I'm not sure whether it was in 2000, I think it might have been in 2000 or in 1999 [] I'm not 100% sure, but I know that the specific result we got from the rebate wine project, that I presented it at the KWV as a lecture. (Heinrich du Plessis, interview 1 (translated from Afrikaans))

Prof Lambrechts stresses the fact that, because WINETECH funded the project, the results are available to anyone in the wine industry. He considers the existing routes of knowledge transfer as sufficient in informing the other local brandy producing companies:

*There were [] publications written, which were published in scientific journals, and there was also an [] adapted version [] published in **Wynboer**, or **WineLand**. And then [] the South African Society for Enology & Viticulture has a conference every year and, at least once, there was a big feedback lecture at such a conference. And this stuff that I'm doing now, it's also for any company to read [] It is at their disposal. (Marius Lambrechts, interview (translated from Afrikaans))*

Informing a scientific community

As listed in Section 4.2, the project generated two scientific articles in international journals, one published in 2002 and one early in 2004. The project also generated eight presentations at national and international conferences.

According to Dr du Toit the topic was a popular one:

It was one of those that, usually if you submit abstracts at conferences [] it's one of those that was relatively quickly chosen for a talk. (Maret du Toit, interview (translated from Afrikaans))

No information is available on the uptake of the research in the international scientific community. However, a citation search on the ISI Web of Science (<http://www.isinet.com/> as on 26 May 2004) revealed that the article in the **Journal of Applied Microbiology** has been cited only once in the ISI journals over the last two years. This was a self-citation (i.e. by Mr du Plessis *et al.* in the article in the **International Journal of Food Microbiology**).

Other

The knowledge that Mr du Plessis acquired on the project he now also applies in his current position at the ARC Infruitec-Nietvoorbij. He mainly works with LAB and MLF – not in the context of rebate wine or brandy but with general MLF problems and LAB identification:

Yes, the knowledge that you acquire basically [] it stays constant and you use it on a daily basis. It's not something that you can unlearn. (Heinrich du Plessis, interview 1 (translated from Afrikaans))

4.5 Comments about this project

The main insight derived from this project is that by having an industry partner that is closely related to a university project, academic research could translate into something useful to industry. To some extent, the research work in the MLF project was tailored to the prevailing circumstances at Distell, and hence found direct application within Distell (even though the strategic implications of the findings are still under discussion). Moreover, the integration of the project findings with other research also occurs within Distell, because the company has a genuine interest in the research application.

The results are also available to other brandy producing companies, and this largely happens through publication in scientific journals and in **Wynboer Tegnies / Technical**. However, within the academic mode of research, the postgraduate student is responsible for writing both the scientific and more technical article. Thus, if the student finds employment immediately after graduation, there is often a delay in publication, and hence also in dissemination. It happened in this case. Mr du Plessis began working at the ARC Infruitec-Nietvoorbij during the last year of project funding (2002) and hence struggled to complete the technical article for **Wynboer Tegnies/ Technical**. The publication only appeared in 2004.

While working at the ARC Infruitec-Nietvoorbij, Mr du Plessis was also the project leader of two other WINETECH sponsored projects on LAB. This happened during the last year of his MSc. These projects were based at the ARC Infruitec-Nietvoorbij. He only got these two projects because of his good work on the MLF project. This provides further evidence of the role that the IWBT (with their supervisory structures, feedback meetings etc.) played in his development as researcher. As Mr du Plessis explains:

[The MLF project] basically led to my whole development [] if it wasn't for that project I probably never would have gotten involved with the

WINETECH project here at Nietvoorbij [] The only reason I got involved was because there was a gap for a lactic acid specialist and because I worked with lactic acid bacteria before, they basically called me and said I already have the knowledge and I have a good record [] (Heinrich du Plessis, interview 2 (translated from Afrikaans))

5 Project 3: Sources of acetic and other fatty acids and their role in sluggish or stuck fermentations

5.1 Project history

In the past, the occurrence of volatile acidity in winemaking was almost synonymous with unhygienic cellar practices. Hence, winemakers who experienced high levels of volatile acidity in their wines often lacked the confidence to talk about the problem, with the result that no one considered volatile acidity to be a serious problem in the South African wine industry. However, in the late 1990s, through informal conversations with winemakers, Prof Lambrechts realised that the occurrence of volatile acidity was not as uncommon as had previously been assumed. In fact, complaints about excessive volatile acidity even emerged in cellars that were known for excellent standards of cellar hygiene. He immediately thought of it as an interesting topic for research and submitted a concept project proposal to WINETECH for funding consideration.

Initially, WINETECH did not believe Prof Lambrechts that volatile acidity constitutes a real problem within the local wine industry. According to him he first had to convince them about the seriousness of the problem. WINETECH subsequently funded it, and the project officially started in 1999 and continued until 2002. The Microbiology Committee at WINETECH monitored the project.

Before looking into the project specifics, we will first unpack the ‘informal conversations’ that Prof Lambrechts had with the winemakers, as these were important research triggers. The discussions were of two kinds. First, there were discussions that originated from troublesome wines that the winemakers brought to Prof Lambrechts (while he was still at the IWBT) to test for bacterial activity. Secondly, conferences and workshops also provided Prof Lambrechts with the opportunity to find out what was in fact happening at the cellars:

[] at conferences, at workshops, which were about other things, but during teatimes, lunches, etcetera, people usually chatted to the winemakers. So with an informal chat [] where you don't ask a specific question, but you do ask questions to check what's going on in the industry, to put it this way [] With the type of questions you ask you often get a lot of information, or you see but here is a trend, here is actually a lot of people who talk about the same thing. Is there not a possibility for research? (Marius Lambrechts, interview (translated from Afrikaans))

After Prof Lambrechts left the IWBT in 2001 for his current position with Distell, Dr du Toit became the project leader and guided the project until its completion. Before that, however, Dr du Toit was already involved in the project as a postdoctoral fellow at the IWBT because, in her own words, “wine spoilage constitutes one of my passions.”

5.2 Key project descriptors

Project objectives

The following extract from the final report to WINETECH, in 2003, captures the overall project objectives:

Numerous problems with incomplete or stuck fermentations are often experienced in red wine making. These wines often contain high levels of volatile acidity, which are degrading to wine quality. High levels of acetic acid can occur in wines undergoing stuck fermentation, but the source(s) of this as well as if these high levels of acetic acid are responsible for the stuck fermentation is unknown. It is also not known if these higher levels can be attributed to the stuck fermentation.

This project aimed to evaluate [] four different groups of microorganisms associated with wine making for their possible contribution in volatile acidity [Acetic acid bacteria (AAB), lactic acid bacteria (LAB), non-Saccharomyces yeasts (i.e. wild yeasts) and commercial wine yeast strains].

No research has been done on the origin and sources of the high levels of acetic acid in South African wines. We believe that this research could provide answers to the short as well as long-term problems being experienced annually with stuck fermentation and high levels of volatile acidity in red wine making.

Therefore, the overriding goal of this project is to determine whether acetic acid bacteria, lactic acid bacteria, non-Saccharomyces yeasts or commercial wine yeasts are responsible for the above average acetic acid production in some red wine fermentations and to advise the industry on the prevention of acetic acid production. (WINETECH final report 2003)

Size and composition of team

It is difficult to speak of a 'research team' in the true sense of the word. Apart from Dr du Toit and Prof Lambrechts, there were five postgraduate students who worked on different parts of the project (i.e. different microorganisms) at various times over the four-year period. They were:

- ◁ Mr Wessel du Toit, who worked on AAB (for a MSc)
- ◁ Mr Adriaan Oelofse, who also worked on AAB (for both a Hons BSc and MSc)
- ◁ Mr Jacques Ferreira, who worked on commercial yeast strains (for a MSc)
- ◁ Ms Jenni Erasmus²⁰, who worked on LAB (for a Hons BSc), and
- ◁ Ms Jill Bergstedt, who worked on wild yeasts (for a Hons BSc).

Sources of funding

WINETECH funded the project but was not the only industry funding body. Anchor Biotechnologies²¹ also contributed financially because of the focus on commercial yeast

²⁰ Ms Erasmus' maiden name is Bayly. This name also appears in the list of project outputs in the appendix.

strains. In addition, THRIP equalled the total amount of funding made available by WINETECH and Anchor Biotechnologies.

Project outputs

The project has generated a significant number of outputs, among which student theses, publications in local and international journals, as well as paper and poster presentations at various conferences. The categories and numbers of outputs are specified in the appendix.

What were the project findings?

This project aimed to evaluate the four different groups of microorganisms associated with wine making for their possible contribution in volatile acidity. The first group that was studied is the acetic acid bacteria (AAB) and results obtained indicated that *Acetobacter pasteurianus* and *Acetobacter liquefaciens* are the dominating species. Their growth during fermentation is highly dependent on the pH of the must. Certain acetic acid bacteria under certain conditions proved able to produce high levels of volatile acidity (VA) in must, which led to stuck/sluggish fermentations. The second group under investigation was the lactic acid bacteria (LAB). Their growth was influenced by pH, as well as SO₂ addition to the must. Most of the strains tested produced VA levels of 0.5 g/L. The non-*Saccharomyces* yeasts were also investigated and results obtained showed that certain species of *Kloeckera* and *Candida* produced levels of 0.6 to 0.9 g/L with concomitant high levels of ethyl acetate. The amount of VA produced by these wild yeasts was influenced by the winemaking practices, such as cold maceration, skin contact and thermovinification. The last group investigated is the commercial wine yeast strains. Results obtained indicate that the *S. cerevisiae* strains differ in the amount of VA produced. Certain strains produced higher VA than others, but in general VA production increased with an increase in the initial sugar concentration of the must. The interaction between commercial yeasts, acetic acid and lactic acid bacteria showed that the yeast type does not influence the AAB counts, but can influence the LAB counts, due to higher SO₂ production. Differences in fatty acid production between the different inoculations were also observed, although these levels are probably not high enough to adversely affect the malolactic fermentation per se. It is thus clear that high VA levels can be formed in fermenting musts due to the survival and even growth of wine bacteria and non-*Saccharomyces* yeasts during fermentation, in which the pH plays an important role.

Source: WINETECH final report (2003)

5.3 Mode of knowledge production

In discussing the mode of knowledge production, we will first consider the role of Anchor Biotechnologies as a funding body. Secondly, since a group of postgraduate students produced the knowledge, we will also look at the extent of student interaction and supplementation, and the integration of their respective findings.

²¹ Anchor Biotechnologies services niche markets with 'bio-solutions' in the wine, whisky, commercial brewing, and bio-control industries. It is a business unit of Anchor Yeast, which is a market leader in yeast technology in Southern Africa. It dates back to 1923 when the first yeast factory was started in Cape Town, South Africa (<http://www.anchor.co.za/>). Moreover, Anchor Biotechnologies is one of only three yeast manufacturers in the so-called 'new world wine producing countries'. ['New world wine producing countries' are countries such as New Zealand, Australia and the USA.]

Anchor Biotechnologies as funding body

Although prior to the project it was known that commercial wine yeast strains could produce high levels of acetic acid, it was not initially the plan to investigate the conditions under which commercial yeast produces acetic acid. However, as it happened, Anchor Biotechnologies was interested in funding some IWBT projects and, in discussions with Prof Lambrechts, decided on the stuck fermentation project. As a result, an investigation into the volatile acidity associated with some of Anchor's yeast strains was also added. The apparent reason was that Anchor saw it as an opportunity to know more about their yeasts' ability to produce these volatile or fatty acids. But there was no formal request from Anchor's side to do the research.

Moreover, Anchor Biotechnologies did not place any demands or constraints on the research workers, nor did they formulate additional requests. All that they wanted, according to Prof Lambrechts, was that the South African wine industry should be informed about the occurrence of volatile acidity:

We told them [Anchor Biotechnologies] what we were going to do and they were satisfied with it. All they wanted, you know, was that it should be made available and that stuff must be written so that the industry can know that there is a volatile acidity problem because they [Anchor Biotechnologies] also saw it as [] quite a problem [] (Marius Lambrechts, interview (translated from Afrikaans))

Thus, one could argue that Anchor Biotechnologies wanted the research to confirm and back their own awareness and perception of the problem. Unfortunately, the employee who negotiated the project funding is not with Anchor anymore. Nevertheless, according to Ms Karien Lourens, who is a technical consultant (wine ingredients) at Anchor Biotechnologies and who advises winemakers on yeast products, it is desirable to have empirical evidence that supports practical experience:

It's always nice to have the research as back-up because when you talk to winemakers you can say, look, the cause of sluggish fermentation [] we found in the research as well as in practice, say, for argument's sake, that 0.7g per litre volatile acid concentration inhibits the growth of yeast. So it's always nice when you talk to winemakers to say, you know, practically the guys [other winemakers] say if they reach this VA [volatile acidity,] then they cannot do further fermentation, and we have tested it at the university, and it is in fact so. (Karien Lourens, interview (translated from Afrikaans))

In general, Anchor Biotechnologies funds yeast related projects that serve the interest of the whole wine industry, as highlighted by Ms Lourens in the following quote:

We don't necessarily fund projects that will give us a product [] We also fund a project if it concerns fermentation and if it will provide the industry with information, etcetera. In other words, we do not make money out of it directly, but [] strategically it is to our advantage [] because it's to the advantage of the whole industry that the research is being done. (Karien Lourens, interview (translated from Afrikaans))

Moreover, Anchor's funding of the stuck fermentation project was probably also influenced by a desire to strengthen existing relations with the University of Stellenbosch. According to Ms Lourens, Anchor Biotechnologies has very good ties with the university. The company also funds a major yeast breeding and selection programme at the IWBT, and each year, provides a yeast strain and enzyme free of charge to the university, for the latter to use in its experimental and commercial cellars.

As said, Anchor Biotechnologies maintained a 'hands-off' approach during the course of the project. They were regularly informed about the project and when a report was due for WINETECH, Anchor also received one. What they did with the reports, as well as their uptake of the findings, will be discussed in Section 5.4.

An agglomeration of postgraduate student work

In 1997, Mr Wessel du Toit, while doing his honours in Wine Biotechnology, was asked by a lecturer in Oenology, Mr Loftie Ellis, to start working on bacterial activity in wine. He eventually concentrated on acetic acid bacteria (AAB) because it constituted a niche area. It also formed the topic for an MSc, which he conducted between 1998 and 1999. Prof Lambrechts was Mr du Toit's supervisor, and Mr Ellis his co-supervisor. In 1998 Prof Lambrechts applied for project funding to WINETECH to investigate the role of AAB in volatile acidity, together with that of LAB, wild yeast and commercial yeast strains (all within the context of stuck fermentations). The funding formally began in 1999, the second year of Mr du Toit's MSc.

Also in 1999, Ms Jenni Erasmus joined the project as an honours student. Her specific role was to study the conditions under which LAB produce acetic acid. According to Ms Erasmus:

I did not choose the topic. We were put in to various groups according to our interests and then asked if we would like to work on a particular project. I was asked if I would like to work with Wessel [Mr du Toit] on a project and did so as any project would be good experience considering our lack of experience after only completing a BSc. Marius [Prof Lambrechts] had already been working on this project for a year and I joined the team working on it. (Jenni Erasmus, e-mail)

Prof Lambrechts was Ms Erasmus' supervisor. However, in 1999, he took six months leave, meaning that Mr du Toit had to help her most of the time. Mr du Toit, according to Ms Erasmus, was 'kind of in charge' of the project in the laboratory. He assisted her on a daily basis. At that stage Dr Maret du Toit was also part of the IWBT and provided valuable help to Ms Erasmus.

There was no molecular work involved in Ms Erasmus' research and not much in Mr du Toit's either, as he largely characterised the AAB in terms of wine conditions. At the end of 1999, both the AAB and LAB components of the WINETECH project were completed (Mr du Toit's received his MSc and Ms Erasmus' her honours degree). Thereafter, Mr du Toit moved to industry for a period of two years and Ms Erasmus continued with an MSc in wine aroma and yeast.

In 2000 the work on the wild yeast component began. Ms Jill Bergstedt was working as a technician at the ARC Infruitec-Nietvoorbij, and the institute sent her to do an honours degree in Wine Biotechnology. She enrolled part-time and completed the qualification over a period of two years. At that stage Nietvoorbij had a project running on wild yeast, under the leadership of Dr Neil Jolly, and the topic fitted in nicely with the WINETECH project. Ms Bergstedt's part of the WINETECH project involved no molecular work. Her supervisors were both Prof Lambrechts and Dr Jolly. Since Ms Bergstedt was based at the ARC Infruitec-Nietvoorbij, most of her practical work was conducted at Nietvoorbij, meaning Dr Jolly was her main advisor. At times, however, Ms Bergstedt and Dr Jolly would consult Prof Lambrechts together. The wild yeast component was completed at the end of 2001.

The commercial yeast component started in 2002. Before looking into that, we first need to explain some developments within the AAB side of activities. Prof Lambrechts felt that there was still scope for more research into AAB and told Mr Adriaan Oelofse, an honours student in Wine Biotechnology, that if interested, he could continue with Mr du Toit's work. This happened in 2000, the same year when Ms Bergstedt was doing her honours. What Mr Oelofse subsequently did, was to screen the AAB isolates of Mr du Toit in order to determine the associated levels of volatile acidity. However, by doing so, he realised the potential of screening the AAB for their ability to produce antimicrobial peptides. After discussions with Prof Lambrechts, it became the topic of Mr Oelofse's MSc, which he started with in 2001. His research was completed by the end of 2002 and the main supervisor was Dr du Toit. The end result is regarded as novel work.

Early 2002, Mr du Toit returned from industry and started working as a lecturer in the Department of Viticulture and Oenology. At that time, Prof Lambrechts was not with the IWBT anymore and Dr du Toit had taken over the leadership of the WINETECH project. Together Dr du Toit and Mr du Toit embarked on the last stage of the project, namely the research into commercial yeast strains and volatile acidity. The task was allocated to Mr Jacques Ferreira, an MScAgric student in Oenology. Mr du Toit was the supervisor and Dr du Toit the co-supervisor. Mr Ferreira's tasks involved the making of wine in the university's cellar with different commercial yeast strains, and the subsequent analysis and testing thereof in the laboratory. The yeasts strains were provided by Anchor Biotechnologies, as well as by Lallemmand and Columbus. His research has recently been completed and he will graduate at the end of 2004.

Extent of student interaction. In retrospect, there seems to be only two instances of significant research interactions between the postgraduate students. Both instances involved Mr du Toit. The first happened during his second year of MSc when Ms Erasmus, an honours student, joined the project. Apart from him assisting and guiding her in the laboratory, they also shared a fieldwork component. The two of them had to collect wine samples (e.g. fermenting red musts) from commercial cellars for their respective research activities.

The other instance occurred much later in the project, when Mr du Toit (as lecturer) became the supervisor of Mr Ferreira. As Mr Ferreira explains:

[] my two supervisors, the one [Mr du Toit] is in the lab, so I saw him every day. We talked about my project every day as well as about my progress. (Jacques Ferreira, interview (translated from Afrikaans))

There were also instances of casual research interactions between the postgraduate students, and these mostly involved Mr Oelofse. He describes these interactions with three of the others as follows:

Jenni [Erasmus], because she concentrated more on lactic acid bacteria, there definitely is a difference, but she also tested for VA. You talk to each other, you see each other in the labs and if there's something that I don't know or if I need to know how to do a certain technique and she has done it, I'll definitely go to her. I talked to her, I asked her have you looked at this or did you follow this technique this way, did you do the purifying like this. I also did it but it doesn't seem to be working and then we talk about it a bit. (Adriaan Oelofse, interview (translated from Afrikaans))

Jill [Bergstedt] and I started together in my honours year. So I knew her, she was in my class and, yes, here and there [] especially the technique for volatile acid determination I showed her how to do it, how I did it and then the comparison of what I got and so on. (Adriaan Oelofse, interview (translated from Afrikaans))

Jacques [Ferreira] only started later with his work, but Jacques for example [] he's now using my thesis for example. He's looking at my thesis, looking at my references, how it was written, how a structure follows, and techniques. (Adriaan Oelofse, interview (translated from Afrikaans))

An important linking mechanism was the laboratory and group meetings at the IBWT. Although the five postgraduate students were in different years of training, each of them had known what at least one other student was doing on the project. This was because of regular postgraduate meetings at the IWBT, which involved all students.

We had group meeting as well as lab meetings once a week. Group meetings were just for those in a particular leader's group, e.g. Maret's group etc., and lab meetings were for the whole of the IWBT. (Jenni Erasmus, e-mail)

Integration of project findings. Only Ms Erasmus has seen some of her work integrated with that of another student, namely that of Mr du Toit.²² None of the other students have ever seen their work integrated with those of others. The lack of integration can be ascribed to the reporting requirement of WINETECH (i.e. the annual progress report must be restricted to the developments of the past year with only a short summary that describes the project development from the start).

²² This question was not put to Mr du Toit because he was part of the project leadership towards the end.

Also, as far as the writing of the WINETECH reports are concerned, it seems that most of the work was not written by the students. Only Mr Ferreira recalled writing his own section for the report.

5.4 Mode of knowledge utilisation

Anchor Biotechnologies co-funded the project and provided some of the yeast strains for Mr Ferreira's part of the project. Although Mr Ferreira's research comprises only one of four components, Anchor Yeast nevertheless received a copy of all WINETECH progress reports, as well as copies of the two articles that Mr Ferreira wrote and which are currently under submission. It is therefore important to investigate their uptake of the research results.

Anchor Biotechnologies as an intermediate disseminating body

All research reports that Anchor Biotechnologies receives are read by the technical manager, Dr Graham Reid, the three technical consultants (of which Ms Lourens is one), as well as by the director of the business unit. Thereafter Dr Reid files it. This means that the knowledge is largely embodied within certain individuals. These individuals (primarily the technical consultants) can be regarded as transfer agents in the sense that they communicate the knowledge to the end-users, i.e. the winemakers. This happens in one of two ways. The first is through interaction and consultation with winemakers, and second, through practical articles in a gazette that is distributed to about 400 winemakers.

Interaction and consultation with winemakers. Anchor Biotechnologies' interactions and consultations with winemakers are either in the form of visits to the cellars – because the technical consultants visit both clients and non-clients – or telephonic conversations. It is during these consultations that the technical consultants communicate to the winemakers the information contained in the project readings:

Naturally I have the knowledge – mainly in my head because I read the stuff [project reports] and if I talk to winemakers before or during a season [season is from January to April], then I give them that information. (Karien Lourens, interview (translated from Afrikaans))

However, the technical consultants do not necessarily communicate to the winemakers the findings of any specific report. Once read, the findings of a report are stored in the consultant's head, where it becomes integrated with other sets of information. In other words, it becomes part of a collective pool of knowledge, which can be tapped into during consultation. What are examples of these other sets of information? Three things emerged from the interview with Ms Lourens: own desk research, other project reports that she has read, and the wine industry itself. Other project reports are obvious, and the desk research we will look at when we discuss the **Outlook** gazette. But how can the industry also provide information?

Again, it occurs during the technical consultant's interaction with the winemakers, when advice and feedback are exchanged:

I sit in front of the winemakers and tell them what works and what doesn't work and they tell me I use this type of yeast at this temperature and then it doesn't work or I use it here and it works perfectly, you know. So []

ultimately it's the practical commercial information [] at the end of the day it's the information that's most important because often what you see and do in the lab is not feasible or possible in practice. (Karien Lourens, interview (translated from Afrikaans))

Thus, the collective pool of knowledge that is drawn upon during consultation not only involves scientific findings but also the experiences and practices of winemakers. Within a single technical consultant, then, there are pieces of information representing both science and practice, and these are constantly integrated and played against each other. What the aforementioned quote further reveals is that more 'grass root' types of knowledge often enjoy preference in the integration process, and that the scientific information is used to back up practices (see again Section 5.3). However, this is not always the case. Sometimes scientific information can also be used to disprove a certain winemaking practice. We will look at this in the discussion of the **Outlook** gazette, where we briefly refer to Ms Lourens' desk research into the role of glycerol in winemaking.

Moreover, since the integration of science and practice (and sense making) occurs in the head of the technical consultant, and improved winemaking practices are the ultimate goal, it follows naturally that whatever is communicated to winemakers will also be more practical. This not only applies to communications through consultation but also to communications in the form of articles. This brings us to the **Outlook** gazette.

The Outlook gazette. The **Outlook** is an A3-size gazette that Anchor Biotechnologies publishes twice a year and which is sent free of charge to any winemaker or person in the wine industry who would like to have a copy. It is the joint responsibility of Ms Lourens and Dr Reid and contains articles in both English and Afrikaans. It is not distributed electronically but via ordinary mail:

We post it. We still believe in the old way [] we obviously have a website where we do everything electronically but we believe, you know, that there's nothing like the 'human touch'. It doesn't matter how modern the winemakers get, they still want to be visited and they still want something they can physically hold in their hands. So that's why we still send out the newspaper [] everyone reads it. If you want to send out information to the wine industry you put it in the Outlook because, believe me, they read it from start to end. (Karien Lourens, interview (translated from Afrikaans))

The **Outlook** gazette is sent to about 400 winemakers and is reported to be very popular among the winemaking community because of its practical content. Articles are written by the employees of Anchor Biotechnologies as well as by invited researchers. Both Prof Lambrechts and Dr du Toit wrote articles for **Outlook** during the course of the stuck fermentation project. The details of these articles are:

◀ Prof Lambrechts

January 1999: The origin of acetic acids in wine. (In English)

August 1999: The effect of high sugar concentrations on yeast cells. (In Afrikaans)

January 2001: Bacteria in red wine. What are the facts? (In Afrikaans)

January 2002: Does high volatile acidity leave you without any hair? (In Afrikaans)



Dr du Toit

January 2002: Lactic acid bacteria. Friend or foe? (In English)

It is difficult however to determine exactly how much of the stuck fermentation project went into these articles, given that they most probably also involve insights from other projects on which the researchers had been working. Suffice to say that at least some of the information has been communicated via the **Outlook** gazette. According to Ms Lourens:

[] the information that they got from the project, from their research, they have incorporated into the articles that they wrote for us, popular articles, for this newspaper of ours [] So winemakers know by now that they have to suppress the growth of acetic acid bacteria. They know what stimulates the growth thereof [] They also know that they have to suppress lactic acid bacteria so that it doesn't start growing at the wrong time. If it starts growing at the right time it's not harmful, so then it's fine, but we definitely give [] the information [] in a practical way we pass it on to the wine industry. (Karien Lourens, interview (translated from Afrikaans))

Apart from invited contributions, technical consultants at Anchor also write for the **Outlook** gazette. Ms Lourens herself wrote two articles on the issue of stuck fermentations. She however did not consult any of the project results to write these two articles. She primarily used textbooks but admits that indirectly she could have used something from their work, simply because she read all their reports.

Ms Lourens and Dr Reid are the ones who decide about what to publish in the **Outlook** gazette. 'having an ear on the ground' usually does this. For instance, should a number of winemakers contact Ms Lourens about a similar topic or problem, she would follow it up with a literature search and publish her conclusions in the form of a small article in **Outlook**. An example is the article on the role of glycerol in winemaking that will appear in the July 2004 edition. For more than four years winemakers have repeatedly contacted Ms Lourens to enquire about which yeast strain produces the most glycerol (winemakers believe that glycerol adds sensory value to wine). The positive contribution of glycerol, however, according to Ms Lourens, is an urban legend that is exploited by sales representatives to sell products to winemakers. Hence, Ms Lourens conducted her own investigation – i.e. a literature search or desk research – to refute the legend, and wrote an article for **Outlook**.

Other times Ms Lourens would just get a feeling of the latest 'buzz' in the winemaking community and write something about it. She would also phone winemakers, those she has identified as so-called 'opinion leaders', and ask them about current concerns in winemaking practices. This provides another explanation for the popularity of the **Outlook** gazette – largely the winemakers themselves are determining the content.

Most of the articles that appear in the **Outlook** gazette are also placed on the website of Anchor Biotechnologies (<http://www.newworldwinemaker.com/>).

Lastly, Ms Lourens underscores the need for repetitive reporting of project results as winemakers tend to forget. If a project's results appear in various forms in both **Outlook** and **Wynboer Tegnies/ Technical**, it will eventually reach fertile ground:

*[] how it works in the industry, you have to give out more or less the same information on a regular basis [] because the guys read the **Outlook** and forget about it again. Then you have to try to give them the same kind of information at a later stage. (Karien Lourens, interview (translated from Afrikaans))*

In summary then, the role of Anchor Biotechnologies as an intermediary is that of a vehicle of knowledge transfer. Knowledge is received from the domains of both science (in codified form) and practice (in tacit form), and is integrated and communicated to winemakers in a practical way. The integration process happens within individuals, meaning that dissemination is very much dependent on the individuals who comprise the business unit. But the role of Anchor Biotechnologies, as an intermediary, is more than that of a vehicle of knowledge transfer. Anchor also acts as a mediator between science and practice, in the sense that it lessens the distance or space between researchers and winemakers.

Mediating the relationship between science and practice. Anchor Biotechnologies maintains a good relationship with both the IWBT (e.g. Ms Lourens and Dr du Toit studied together) and the winemaking community. Because their outreach is to both sides, they constitute an indirect link between the IWBT and the cellars. However, Anchor also facilitates a direct link between the winemakers and the IWBT. As Ms Lourens explains:

If they [winemakers], for example, get sluggish fermentation, then my advice to them would always be – get the wine analysed. Determine the volatile acid, go look at what the bacterial count is. Send your stuff to Stellenbosch University so that they can say what kind of bacteria it is that's growing there, so that you can know what the cause is [] (Karien Lourens, interview (translated from Afrikaans))

Thus, through referrals, Anchor Biotechnologies is closing the gap between science and practice, and creating opportunities for more contact between researchers and winemakers. Prof Lambrechts partly came to the idea for the fermentation project by testing the wines that some winemakers had brought to him. Similarly, Dr du Toit also regards the testing of wine as a significant research trigger:

[] the samples that pass here broaden your knowledge, also in terms of projects because you see interesting stuff that might give you an idea for something new. So, I mean, it's interesting for me to observe because [] you learn from every wine and every problem that pass here, which you eventually could go and apply in some of your research projects. (Maret du Toit, interview (translated from Afrikaans))

Anchor Biotechnologies, then, by referring winemakers to the university for testing of wines, is generating space for more industry relevant research to be initiated.

Diverse disseminations and utilisations

Apart from disseminating the project results to the scientific community via peer-reviewed publications and paper and poster presentations at conferences, the interviews with the postgraduate students and Dr du Toit and Prof Lambrechts have also revealed other uses of the results.

Winemakers are the first group of users. Usually they want to test their wines for AAB activity. They can apply the media that Mr du Toit developed in his research and which were published by SASEV in a manual (“Methods of analysis for wine environments”).

More often than not they would contact the IWBT or the Department of Viticulture and Oenology for these tests. Mr du Toit remembers various situations:

[] quite often people will contact me because they think that their wine is spoiled, because they know I work on bacteria that cause spoilage and every now and then they will also bring wines [] (Wessel du Toit, interview (translated from Afrikaans))

Mr Oelofse also recalled being asked to do this for winemakers. His identification methods, because of the molecular techniques involved, are more difficult to apply but probably more accurate than those of Mr du Toit. The winemakers could also contact routine labs to do these analyses, such as Vinlab in Stellenbosch, but the skills to do so are concentrated at the IWBT and Department.

Producers of vinegar are the second group of users. They predominantly contacted Mr du Toit on the basis of his articles in **Wynboer Tegnies / Technical**.

Yes, with the popular stuff we had some enquiries but actually it was more from people who want to make vinegar than from viticulturists. (Wessel du Toit, interview (translated from Afrikaans))

Undergraduate and postgraduate students in Oenology at the University of Stellenbosch are the third group of potential users (in the sense that some of them will become future winemakers). Potentially, they could receive the knowledge via Dr du Toit who teaches the modules in wine spoilage and bacteria.

Usually if it's undergraduate it will be reworked to fit into the class notes. But [] the facts are still there, it's not as if they have disappeared. If it's postgraduate, then in a lot of the cases, it's a matter of okay, here's the article and then it gets discussed. (Marius Lambrechts, interview (translated from Afrikaans))

According to Prof Lambrechts, **manufacturers and sellers of commercial LAB** could also use the results. However, the LAB results were only communicated in a scientific journal (article in press) and at a SASEV conference. The sellers of commercial LAB do not seem to have been specifically targeted.

Lastly, the **manufacturers and sellers of commercial yeast strains** could also use the results. Here there is a great potential for utility, as we have seen in the case of Anchor Biotechnologies. Mr Ferreira's articles were also distributed to Lallemand, the other yeast

manufacturer who provided yeast strains for the research. The uptake by Lallemand, however, was not investigated.

5.5 Comments about this project

In cases where more than one master's student works on a WINETECH project the mode of knowledge production at the IWBT inadvertently contributes to a lack of research integration. The reason is that each master's student must produce an own publication, which should be significantly different to that of any other master's student. Where honours students are involved, there is not that strong a pressure for separate work:

[] an honours degree does not depend on a publication and it's not, I want to say, dependable on original work per se [] And the project is relatively small because honours students do a tremendous number of other subjects and stuff as well. So we usually took the honours students and let them work to complement a M-student [] If it's two M-students, then there must be a clear dividing between the two projects so that each can get his own publication. (Marius Lambrechts, interview (translated from Afrikaans))

In this particular project, the master's students were from different study years. Moreover, three people were responsible for the project leadership (Prof Lambrechts, Dr du Toit and Mr du Toit). All of these factors resulted in a lack of integration of the project results. The reason for saying this is that the only place where the results of all the postgraduate work are summarised is in the final WINETECH report (as an abstract of 250 words). This also appears on the WINETECH website. In fact, the different results are only listed. There is no attempt at integration and discussion of the combined findings.

Moreover, the AAB activities seem to overshadow the others. For instance, four articles on AAB have appeared in **Wynboer Tegnies / Technical** but none on the other topics. Although this could be ascribed to the diligence of Mr du Toit, there is another valid reason. Prof Lambrechts explains:

Previously there were many publications, I say many, but there have been enough publications on wild yeasts to show that they can produce high levels of acetic acid. Lactic acid bacteria are organisms that have been worked on a lot already and the conditions by which they produce acetic acid are actually known. So it really wasn't necessary for us to do that research project because you're more or less going to reinvent the wheel [] We actually know under which conditions wild yeasts, lactic acid bacteria and your commercial yeasts produce acetic acid. (Marius Lambrechts, interview (translated from Afrikaans))

Because of its relatively greater importance, the AAB component was given to a master's student and the LAB and wild yeast components to honours students. Although we previously said that Anchor did not place any demands on the researchers, one could argue that their funding contribution resulted in the commercial yeast component also being allocated to a master's student.

Lastly, if one looks at the possibilities of utilisation in Section 5.4, then it seems that utilisation is more likely when:

- ◀ There is some sort of direct link with the IWBT (e.g. Anchor Biotechnologies who fund IWBT projects and also provide yeast strains, or winemakers who bring their wines to the IWBT to be tested); or
- ◀ There is a publication in a popular journal (e.g. vinegar makers who contacted Mr du Toit on the basis of his articles in **Wynboer Tegnies / Technical**).

The most valuable contribution from studying this particular project is that it has highlighted the role of intermediaries. The interesting thing is that Anchor Biotechnologies traditionally is not meant to be an intermediary between the knowledge producers and the knowledge users. Their primary objective is to make profit. But to communicate accurate and useful information, which would enhance both their service and integrity, they need to incorporate the findings of research in their dealings with winemakers.

6 Insights derived from the three projects

6.1 Two project trajectories

A core feature of the research conducted at the IWBT is that postgraduate students are research workers on WINETECH projects. This implies that each project has two trajectories: an academic trajectory and an industry one. Moreover, each trajectory has its own objective and 'rules of the game'. In the case of the academic trajectory, a student must graduate and the university and IWBT have certain requirements and expectations in this regard. For instance, the research must be of a high standard, be subject to internal and external evaluation, conducted under thorough supervision and have at least one publication as output, if produced by a master's student. If more than one master's student works on the same project, then the supervisor must ensure that each student's piece of research is sufficiently unique to result in a separate publication. Thus, largely, scientific publishing drives the mode of knowledge production within the academic trajectory. This is evident in all three projects: all postgraduate students, even honours' students, have produced one scientific article that was not co-authored with any other student who worked on the project.

The second trajectory, the industry one, is largely regulated by WINETECH and its technical and specialist committees – from the project start in its initial proposal stage, to the submission of the final report. The specialist committee must decide about the value of the research to industry, and its continued funding, and for that reason exclusively or almost exclusively comprises industry members. The microbiology committee, for instance, has only industry representatives. According to Dr Gert Loubser, the chair of that committee, the operating principle is that industry itself should decide about the relevance of the project. The industry representatives are all technically skilled, as the scientific merits of the projects also need to be considered. Since the expected outcome is relevance to industry, the research needs to be disseminated to industry. This is largely done through presentations at SASEV meetings and forums, and, most significantly, through publications in **Wynboer Tegnies / Technical**.

WINETECH, as an overarching R&D structure, serves to facilitate the smooth operation and integration of the academic and industry trajectories. It funds projects within academic contexts, and monitors it through progress reports to ensure that the research remains within the interest of the wine industry. Having an academic supervisor, who is also the leader of a WINETECH project, is another way to ensure integration of the academic and industrial trajectories. However, there seems to be one instance where the academic trajectory is incongruent to the industrial one. ['Industry', in the latter sense, is taken to only mean winemakers, not the total wine industry (farmers, winemakers, bottlers, marketers, etc.)]

Let me elaborate: Generally, winemakers' practical experience of wine preparation is that it is a complex and interrelated process. A single change in cellar practice may or may not unchain other negative or positive events. As we have seen in the bitterness project, when Winemaker B started to add more tartaric acid to lower the pH levels of his wine, in order to reduce bacterial problems, his end product became hard and aggressive in taste. Thus, a problem in industry, specifically as it relates to winemaking, has various facets. There is a definite attempt to address the various facets of a problem in the WINETECH reports. For instance the bitterness project approached the problem from a microbiological and chemical perspective, and looked at the role of both yeast and LAB in the formation of bitterness. Similarly, in the stuck fermentation project, the roles of LAB, AAB, wild and commercial yeasts were considered. Thus, various facets are being addressed in the WINETECH projects. However, because of the academic mode of knowledge production, the different aspects of a problem are allocated to different postgraduate students. The outcome is that each of these students publishes a separate scientific article, which is then adapted for the winemaker audience in the form of an article in **Wynboer Tegnies / Technical**. The results that the winemakers receive are therefore fragmented, whereas the initial problem experienced was an integrated one.

The need for integration is not only within a WINETECH project but at times also between WINETECH projects. A good example is the bitterness project where the results of a previous WINETECH project (largely the work conducted by Ms Adele Louw of the ARC Infruitec-Nietvoorbij) need to be incorporated with the present project of Dr du Toit. However, the last project is still ongoing, meaning it is too soon to comment about the extent of integration between projects. But there is definitely a need for an integrated article, according to Winemaker C:

I would like [] them to put together the stuff and give me the total picture and results of all research that has been done on bitterness. Not just Maret's [Dr du Toit] stuff but [] all the stuff that's been done, [] everyone that looked at bacteria and stuff like that. I wanted that stuff to be collected and there must be [] an article must be published, specifically to give more clarity because at the moment I think it's a bit fragmented. You still have to decide for yourself. (Winemaker C, interview (translated from Afrikaans))

So far it looks as if the **Wynboer** article, when it materialises, will also be restricted to the work of Ms Krieling, i.e. only the LAB leg of the project. The reason for saying this is because her scientific article is a compact version of her MSc thesis, and usually it is the scientific article that is being changed into a **Wynboer** article.

The stuck fermentation project represents a good example of a project where, up to now, the results were not communicated to the industry in an integrated fashion. Ideally, one should have asked the winemakers who experienced volatile acidity problems to what extent the results of the stuck fermentation project were communicated to them and whether they considered it to be useful. However, as previously indicated, winemakers are not eager to reveal problems of volatile acidity because it reflects negatively on their cellar practices. Hence, no winemaker who experienced high volatile acidity formed part of the stuck fermentation project, meaning there was no one for us to interview. Be that as it may, only the AAB research has been communicated in **Wynboer Tegnies / Technical**, with a strong possibility of the results of the commercial yeast component also to be published in that journal. But these are all separate articles because they have been investigated separately within the context of the bigger project. Moreover, the results of the LAB and wild yeast components did not appear in **Wynboer** at all, probably because they were honours projects. Admittedly, these studies were reported at SASEV conferences where there is a large attendance of winemakers, but still as separate issues. Also, with regard to the stuck fermentation project, there is a significant time lapse between the various components, together with a change of project leaders. This seems to have worked against proper integration up to this point in time.²³

The only place where the results of the stuck fermentation project are summarised is in the final report to WINETECH, in the form of an abstract of 250 words. There is however no attempt at integration or highlighting the interaction of findings. But what happens to these reports with their project summaries once received by WINETECH? According to Dr Loubser:

The progress reports at this stage, as far as I am aware, are not introduced widely enough in industry, even though the committee members should give feedback to their institutions [] At their own forums and within their own institutions but there are very few of these forums. (Gert Loubser, interview (translated from Afrikaans))

The same procedure is followed with the final report, with the added expectation of a presentation at the annual SASEV conference and/or a publication in **Wynboer Tegnies / Technical**.

All this being said, our investigation has shown that, apart from WINETECH, there are three ways by which a university research project can be tailored to the advantage of industry. The first is through collaboration with a non-university research producer. In the example of the bitterness project, various facets of a problem are addressed through the collaborative project with the ARC Infruitec-Nietvoorbij. Moreover, not all the research results are subject to the rules of the academic trajectory.

A second way by which a university research project could serve the interest of industry is through collaboration with an industry research user. In the case of the MLF project, Distell had close relations with the project (in the form of a project leader that became an

²³ However, at the time of final editing of this case study (October 2004) we were told that WINETECH has requested the IWBT to write an article for **Wynboer Tegnies / Technical** on the findings of the total project.

industry partner, as well as the company's genuine interest in the project). Hence, the results could be tailored to inform Distell's own strategic decision-making.

The third way is via intermediaries who operate between the academic knowledge producers and the industry users. While WINETECH itself can be regarded as an intermediary in the traditional sense (a network that brings together both knowledge producers and knowledge users), there is also the example of Anchor Biotechnologies and its technical consultants.

6.2 Publications for the local winemaking community

There are three research publication channels to the South African wine industry. The first is SASEV, which publishes the SASEV journal and abstracts of SASEV conferences. The second is the **Wynboer Tegnies / Technical** publication in **WineLand**, and the last is the **Outlook** gazette by Anchor Biotechnologies.

All of these together play a valuable role in the wine industry:

I think the SASEV stuff talks to a lot of specific projects. You know it is specifically about the project that's been done [] and the results of the projects, but according to me it's individual projects basically that were circulated in the SASEV stuff. WineLand article are often extracts from that stuff or [] often it's duplication of the stuff [] Outlook again is stuff written by Karien and them but they also looked at what's written in WineLand and then they write their own perspective on the stuff. So, there's a lot of overlapping of this stuff but maybe seen from different perspectives. So, I don't think you can look at only one thing you have to read all this stuff together. (Winemaker C, interview (translated from Afrikaans))

However, the **Outlook** gazette appears to be the most useful to winemakers because it extends the boundaries of any specific project. It combines information from various sources (e.g. WINETECH projects, international research projects, literature studies, communications by winemakers, etc.) into short, intelligible articles. The latter are also very practical in content.

I must say that the stuff that I read in Wynboer, it's not always applicable in practice [] Please, this must be made practical because [] the stuff is very theoretical. (Winemaker A, interview (translated from Afrikaans))

Winemaker A echoed this:

I must say that the stuff that I read in Wynboer, it's not always applicable in practice [] Please, this must be made practical because [] the stuff is very theoretical. (Winemaker A, interview (translated from Afrikaans))

The extent to which other winemakers also share this concern could impact on the utilisation of research findings that are published in **Wynboer Tegnies / Technical**. The issue, then, is not only one about the integration of project findings (as highlighted in Section 6.1) but also one about the 'packaging' of findings.

6.3 Future research

Our study is limited in the sense that we did not focus on the view of winemakers in general. We only interviewed three project participating winemakers (for one project only) and they were all from established wine estates. There is a need to obtain the views of project non-participating winemakers that are representative of the various cellar groupings (private cellars, cooperative cellars etc.). Definitely a better strategy would be to start with winemakers and their cellars as points of departure (not the project leaders and their projects as we did in this investigation). Specifically, the winemakers should be asked whether there was any LAB result that they could meaningfully apply in practice. The result must then be traced back to its dissemination channel(s) and research producer(s). Also, the attitudes of winemakers with regard to R&D and innovations need to be investigated, as this may impact on utility.

Data sources

Face-to-face interviews²⁴

- Dr Maret du Toit (Senior researcher at the Institute for Wine Biotechnology, University of Stellenbosch), 19 February 2004
- Mr Wessel du Toit (Lecturer at the Department of Viticulture and Oenology, University of Stellenbosch, who worked on Project 3 as an MSc student), 28 April 2004
- Mr Jacques Ferreira (Postgraduate student who worked on Project 3), 3 June 2004
- Mr Adriaan Oelofse (Postgraduate student who worked on Project 3), 3 June 2004
- Prof Sakkie Pretorius (Founder and first director of the Institute for Wine Biotechnology, University of Stellenbosch), 22 August 2000

Telephonic interviews

- Ms Jill Bergstedt (Postgraduate student who worked on Project 3), 17 June 2004
- Mr Heinrich du Plessis 1 (Senior researcher at the ARC Infruitec-Nietvoorbij, Post Harvest and Wine Technology Division, who worked on Project 2 as a postgraduate student), 28 April 2004
- Mr Heinrich du Plessis 2 (Senior researcher at the ARC Infruitec-Nietvoorbij, Post Harvest and Wine Technology Division, who worked on Project 2 as a postgraduate student), 17 June 2004
- Mr Neil Jolly (Senior microbiologist at the ARC Infruitec-Nietvoorbij, Post Harvest and Wine Technology Division), 3 May 2004
- Ms Shannon Krieling 1 (Laboratory technician at Distell, who worked on Project 1 as a postgraduate student), 4 May 2004
- Ms Shannon Krieling 2 (Laboratory technician at Distell, who worked on Project 1 as a postgraduate student), 17 June 2004
- Prof Marius Lambrechts (Group research manager at Distell and part-time affiliated associate professor in oenology at the Institute for Wine Biotechnology, University of Stellenbosch), 30 April 2004
- Mr Gert Loubser (Chair of the microbiology technical committee of WINETECH), 14 June 2004
- Mr Pierre Loubser (Manager of the Pinotage Association of South Africa), 14 June 2004
- Ms Karien Lourens (Technical consultant [wine ingredients] at Anchor Biotechnologies), 18 May 2004
- Ms Caroline Snyman (Technical manager [spirits] at Distell), 3 May 2004
- Winemaker A (Winemaker from an established wine estate who participated in Project 1), 28 April 2004
- Winemaker B (Winemaker from an established wine estate who participated in Project 1), 29 April 2004
- Winemaker C (Winemaker from an established wine estate who participated in Project 1), 7 June 2004

²⁴ The author of this case study conducted all interviews, both face-to-face and telephonic. With the exception of the interviews with Ms Jill Bergstedt and Dr Neil Jolly, which were conducted in English, all interviews were in Afrikaans.

E-mail response

Ms Jenni Erasmus (Postgraduate student who worked on Project 3), 17 June 2004

Publications and documents

- Cooper, D (2004) *Two faces of application-oriented research centres at higher education institutions in South Africa: Enhancing creativity and reducing chaos*. Paper presented for seminar series at the Centre for Research on Science and Technology, University of Stellenbosch, 2 April 2004
- Ewert, J & Du Toit, A (2003) *A deepening divide in the countryside: Restructuring and rural livelihoods in the South African wine industry*. Paper presented at a workshop entitled: Standards, trade and value-chains: What role for developing countries? Copenhagen, 5-6 September 2003
- IWBT (2000) *Direkteursverslag: 1995-2000*. Instituut vir Wynbiotegnologie, Universiteit van Stellenbosch
- Krieling, SJ (2003) *An investigation into lactic acid bacteria as a possible cause of bitterness in wine*. MSc in Wine Biotechnology, University of Stellenbosch
- NBS (2003) *National Biotech Survey*. Compiled by Dr Michelle Mulder of Idea to Industry CC, with contributions from Dr Torsten Henschel, a biotechnology industry consultant
- Pretorius, IS (nd) *The tailoring of designer grapevines and wine yeasts for a market-directed and quality focussed wine industry*. Institute for Wine Biotechnology, Department of Viticulture and Oenology, University of Stellenbosch, South Africa
- SAWB (2003) *A strategic plan for a vibrant, united, non-racial and prosperous South African wine industry (version 1, October 2003)*. Prepared by the South African Wine & Brandy Company
- THRIP (1997) *THRIP annual report 1997*. Published by the Foundation for Research Development and the Department of Trade and Industry, South Africa
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- WINETECH (2003) *Annual report 2003*. Published by the Wine Industry Network of Expertise and Technology
- WINETECH final report (2002) *The occurrence of malolactic fermentation (MLF) in rebat wine and its influence on brandy quality: Final report for 2002*. Institute for Wine Biotechnology, University of Stellenbosch
- WINETECH final report (2003) *Sources of acetic and other fatty acids and their role in sluggish or stuck fermentations: Final report for 2003*. Institute for Wine Biotechnology, University of Stellenbosch
- WINETECH progress report (2002a) *The occurrence of malolactic fermentation (MLF) in rebat wine and its influence on brandy quality: Progress report for 2002*. Institute for Wine Biotechnology, University of Stellenbosch
- WINETECH progress report (2002b) *The role of microorganisms in the formation of bitterness in wines: Progress report for 2002*. Institute for Wine Biotechnology, University of Stellenbosch

Websites visited

<http://www.anchor.co.za/>

<http://www.arc.agric.za/institutes/infruit/infruitmain.htm>

www.awri.com.au

<http://www.elsenburg.com/>

<http://www.golfwinesouthafrica.com/sawine.php>

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<http://www.newworldwinemaker.com/>

<http://www.paralegaladvice.org.za/docs/chap15/16.html>

<http://www.sasev.co.za/>

http://www.sun.ac.za/wine_biotechnology

<http://www.veritas.co.za/>

<http://www.winetech.co.za/>

<http://www.wynboer.co.za/>

APPENDIX: LIST OF PROJECT OUTPUTS

Project 1: The role of microorganisms in the formation of bitterness in wines

Two paper or poster presentations at national conferences

- ◀ Krieling, SJ, Du Toit, M, Lambrechts, MG & Pretorius, IS (2002) *An investigation into lactic acid bacteria as a possible cause of bitterness in wine*. 12th Biennial Congress of the South African Society for Microbiology, Bloemfontein
- ◀ Krieling, SJ, Du Toit, M & Pretorius, IS (2002) *An investigation into lactic acid bacteria as a possible cause of bitterness in wine*. 26th Conference of the South African Society for Enology and Viticulture, Somerset West

Two paper or poster presentations at international conferences

- ◀ Krieling, SJ, Pretorius, IS & Du Toit, M (2003) *Isolation, identification and characterisation of glycerol-degrading lactic acid bacteria from South African red wines*. 1st FEMS Congress of European Microbiologists, Ljubljana, Slovenia
- ◀ Krieling, SJ, Pretorius, IS & Du Toit, M (2004) *Wine lactic acid bacteria and their glycerol degradation ability*. 12th Australian Wine Industry Technical Conference, Melbourne

One invited research seminar

- ◀ Du Toit, M (2003) *Bitterness in red wine*. Anchor Biotechnologies 7th Technical Symposium, Spier Wine Estate, Stellenbosch

One MSc thesis

- ◀ Krieling, SJ (2003, cum laude) *An investigation into lactic acid bacteria as a possible cause of bitterness in wine*. MSc in Wine Biotechnology, University of Stellenbosch

Project 2: The occurrence of malolactic fermentation (MLF) in rebate wine and its influence on brandy quality

Two scientific articles published in international peer-reviewed journals

- ◀ Du Plessis, HW, Steger, CLC, Du Toit, M & Lambrechts, MG (2002) The occurrence of malolactic fermentation in brandy base wine and its influence on brandy quality. *Journal of Applied Microbiology*, 92:1005-1013
- ◀ Du Plessis, HW, Dicks, LMT, Pretorius, IS, Lambrechts, IS & Du Toit, M (2004) Identification of lactic acid bacteria isolated from South African brandy base wines. *International Journal of Food Microbiology*, 91:19-29

One technical article published in the WINETECH sponsored popular journal

- ◀ Du Plessis, H, Snyman, CLC, Du Toit, M & Lambrechts, MG (2004) The occurrence of malolactic fermentation in South African brandy base wine. *Wynboer*, 177 (April):81-82

Four paper or poster presentations at international conferences

- ◀ Du Toit, M, Du Plessis, HW, Steger, CLC, Lambrechts, MG & Pretorius, IS (1999) *Lactic acid bacteria and their effect on brandy base wine*. 17th International Conference of the International Committee on Food Microbiology and Hygiene, The Netherlands

- ◀ Lambrechts, MG, Du Plessis, HW, Steger, CLC, Du Toit, M & Pretorius, IS (1999) *The occurrence and influence of lactic acid bacteria on the quality of brandy base wine*. 24th International Wine Congress, Mainz, Germany
- ◀ Du Plessis, HW, Lambrechts, MG, Steger, CLC, Dicks, LMT, Pretorius, IS & Du Toit, M (2003) *The occurrence of malolactic fermentation in brandy base wine and its influence on brandy quality*. 1st FEMS Congress of European Microbiologists, Ljubljana, Slovenia
- ◀ Du Plessis, HW, Lambrechts, MG, Pretorius, IS & Du Toit, M (2004) *The impact of malolactic fermentation on South African rebate wine*. 12th Australian Wine Industry Technical Conference, Melbourne

Four paper or poster presentations at national conferences

- ◀ Lambrechts, MG, Du Plessis, HW, Steger, CLC, Du Toit, M, Dicks, LMT & Pretorius, IS (1999) *Occurrence and characterization of lactic acid bacteria in base wines for brandy making*. 23rd Conference of the South African Society for Enology and Viticulture, Cape Town
- ◀ Du Plessis, HW, Lambrechts, MG, Steger, CLC, Du Toit, M, Dicks, LMT & Pretorius, IS (2000) *The occurrence and characterization of lactic acid bacteria in brandy base wines*. BioY2K Combined Millennium Meeting, Grahamstown
- ◀ Du Plessis, HW, Steger, CLC, Du Toit, M & Lambrechts, MG (2002) *The influence of malolactic fermentation on brandy aroma*. 26th Conference of the South African Society for Enology and Viticulture, Somerset West
- ◀ Du Plessis, HW, Lambrechts, MG, Steger, CLC, Dicks, LMT, Pretorius, IS & Du Toit, M (2004) *The occurrence of malolactic fermentation in brandy production*. 13th Congress of the South African Society for Microbiology, Stellenbosch

One MSc thesis

- ◀ Du Plessis, HW (2002, cum laude) *The role of lactic acid bacteria in brandy production*. MSc in Wine Biotechnology, University of Stellenbosch

Project 3: Sources of acetic and other fatty acids and their role in sluggish or stuck fermentations

Three scientific articles published / to be published in international peer-reviewed journals

- ◀ Bayly, JC, Du Toit, M, Pretorius, IS & Lambrechts, MG (in preparation). The isolation, identification and characterization of lactic acid bacteria occurring in South African red wine fermentations. *Journal of Applied Microbiology*
- ◀ Du Toit, WJ & Lambrechts, MG (2002) The enumeration and identification of acetic acid bacteria from South African red wine fermentations. *International Journal of Food Microbiology*, 74:57-64
- ◀ Du Toit, WJ & Pretorius, IS (2002) The occurrence and esoteric effect of acetic acid bacteria in winemaking. *Annals of Microbiology*, 52:155-179

Two scientific articles for the WINETECH sponsored peer-reviewed journal

- ◀ Ferreira, J, Du Toit, M, & Du Toit, WJ (in preparation). The effect of commercial yeast strains on acetic acid bacteria and lactic acid bacteria numbers during red wine fermentations and malolactic fermentation. *South African Journal of Enology and Viticulture*
- ◀ Ferreira, J, Du Toit, M, & Du Toit, WJ (in preparation). The effect of high sugar and Cu²⁺ on the growth, fermentation and volatile acidity production of different commercial wine yeast strains. *South African Journal of Enology and Viticulture*

Four technical articles published in the WINETECH sponsored popular journal

- ◀ Du Toit, WJ (2001) Die voorkoms van asynsuurbakterieë in S.A. rooiwngistings. *Wynboer*, 142 (May):103-106
- ◀ Du Toit, WJ (2001) Die SO₂ resistance of South African acetic acid bacteria and their effect on fermentation. *Wynboer*, 148 (November):97-101
- ◀ Du Toit, WJ (2001) Winemaking with rotten grapes: it can be a headache. *Wynboer*, December 2002 (<http://www.wynboer.co.za/recentarticles/1202rotten.php3>)
- ◀ Du Toit, WJ, Ellis, LE & Lambrechts, MG (1999) Bronne van asynsuur en ander vetsure in kommersiële rooiwijn fermentasies. *Wynboer*, January 1999, p.55

Eleven paper or poster presentations at international conferences

- ◀ Bayly, JC, Lambrechts, MG, Du Toit, WJ & Pretorius, IS (2000) *The isolation, identification and characterization of lactic acid bacteria occurring during red wine fermentations*. 2nd International Viticulture and Enology Congress, Cape Town, South Africa
- ◀ Du Toit, M, Du Toit, WJ, Lambrechts, MG & Ellis, LP (1999) *Acetic acid bacteria present in South African red wine fermentations and their characteristics*. 17th International Conference of the International Committee on Food Microbiology and Hygiene, Veldhoven, The Netherlands
- ◀ Du Toit, W, Ferreira, J & Du Toit, M (2004) *The effect of high sugar and Cu²⁺ on the growth, fermentation and volatile acidity production of different commercial wine yeast strains*. 19th International ICFMH Symposium, FoodMicro, Portoroz, Slovenia
- ◀ Ferreira, F, Du Toit, M & Du Toit, WJ (2004) *The effect of high sugar and Cu²⁺ on the growth, fermentation and volatile acidity production of different commercial wine yeast strains*. 12th Australian Wine Industry Technical Conference, Melbourne
- ◀ Ferreira, F, Du Toit, M & Du Toit, WJ (2004) *The effect of commercial yeast strains on acetic acid and lactic acid bacteria numbers during red wine fermentation and malolactic fermentation rate*. 12th Australian Wine Industry Technical Conference, Melbourne
- ◀ Lambrechts, MG, Du Toit, WJ, Bayly, JC, Du Toit, M, Bergstedt, JK & Jolly, NP (2000) *Microbiological characterization of wines towards the development of volatile acidity*. 2nd International Viticulture and Enology Congress, Cape Town, South Africa
- ◀ Lambrechts, MG, Du Toit, WJ & Ellis, LP (1999) *The occurrence and characterization of acetic acid bacteria in commercial red wine fermentations*. 6th International Oenological Symposium, Bordeaux, France

- ◁ Lambrechts, MG, Ellis, LP & Du Toit, WJ (2000) *The occurrence and characterization of acetic acid bacteria in commercial red wine fermentations*. 25th World Congress of Viticulture and Wine, Paris, France
- ◁ Oelofse, A, Lambrechts, MG, Pretorius, IS & Du Toit, M (2003) *Characterisation of wine-isolated acetic acid bacteria from South African red wines*. 1st FEMS Congress of European Microbiologists, Ljubljana, Slovenia
- ◁ Oelofse, A, Lambrechts, MG, Pretorius, IS & Du Toit, M (2004) *Characterisation of acetic acid bacteria from South African winemaking*. 19th International ICFMH Symposium, FoodMicro, Portoroz, Slovenia
- ◁ Oelofse, A, Lambrechts, MG, Pretorius, IS & Du Toit, M (2004) *Characterization of wine-isolated acetic acid bacteria from South African red wines*. 12th Australian Wine Industry Technical Conference, Melbourne

Six paper or poster presentations at national conferences

- ◁ Bayly, JC, Du Toit, WJ, Du Toit, M & Lambrechts, MG (2000) *The isolation, identification and characterization of lactic acid bacteria occurring during South African red wine fermentations*. BioY2K Combined Millennium Meeting, Grahamstown
- ◁ Bergstedt, JK, Lambrechts, MG, Jolly, NP & Du Toit, M (2001) *The influence of non-Saccharomyces yeasts on volatile acidity in wines*. 25th Conference of the South African Society for Enology and Viticulture, Somerset West
- ◁ Du Toit, WJ, Ellis, LE & Lambrechts, MG (1998) *Microbiology of S.A. red wine fermentations and colour extraction*. Pinotage Society of South Africa, Stellenbosch
- ◁ Du Toit, WJ, Ellis, LE & Lambrechts, MG (1999) *The occurrence and characterization of acetic acid bacteria in commercial red wine fermentations*. 23rd Conference of the South African Society for Enology and Viticulture, Cape Town
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- ◁ Oelofse, A, Lambrechts, MG, Pretorius, IS & Du Toit, M (2004) *Characterisation of wine-isolated acetic acid bacteria from South African red wines*. 13th Congress of the South African Microbiology Society, Stellenbosch

One invited research seminar

- ◁ Du Toit, M (2001) *Lactic acid bacteria and spoilage*. Seminar on wine bacteria: Winemakers friend or enemy? Department of Viticulture and Oenology, Stellenbosch

Three HonsBSc and three MSc theses

- ◁ Bayly, JC (1999, cum laude) *The isolation, identification and characterization of lactic acid bacteria occurring in South African red wine fermentations*. HonsBSc in Wine Biotechnology, University of Stellenbosch
- ◁ Bergstedt, JK (2001) *The influence of non-Saccharomyces cerevisiae yeast strains on volatile acidity in wines*. HonsBSc in Wine Biotechnology, University of Stellenbosch

- ◁ Du Toit, WJ (2000, cum laude) Sources of acetic and other fatty acids in red wine fermentations. MScAgric, University of Stellenbosch
- ◁ Ferreira, J (2004) Factors influencing the fermentation performance of commercial wine yeasts. MScAgric, University of Stellenbosch
- ◁ Oelofse, A (2000) Characterization of volatile acidity by acetic acid bacteria isolated from South African grape must and wine. HonsBSc in Wine Biotechnology, University of Stellenbosch
- ◁ Oelofse, A (2003) Isolation and characterization of the antimicrobial peptides produced by *Acetobacter aceti* and *Acetobacter pasteurianus*. MSc in Wine Biotechnology, University of Stellenbosch

Two sets of technologies developed

- ◁ Isolation procedures for acetic acid bacteria
 - ◁ Identification techniques for acetic acid bacteria
-

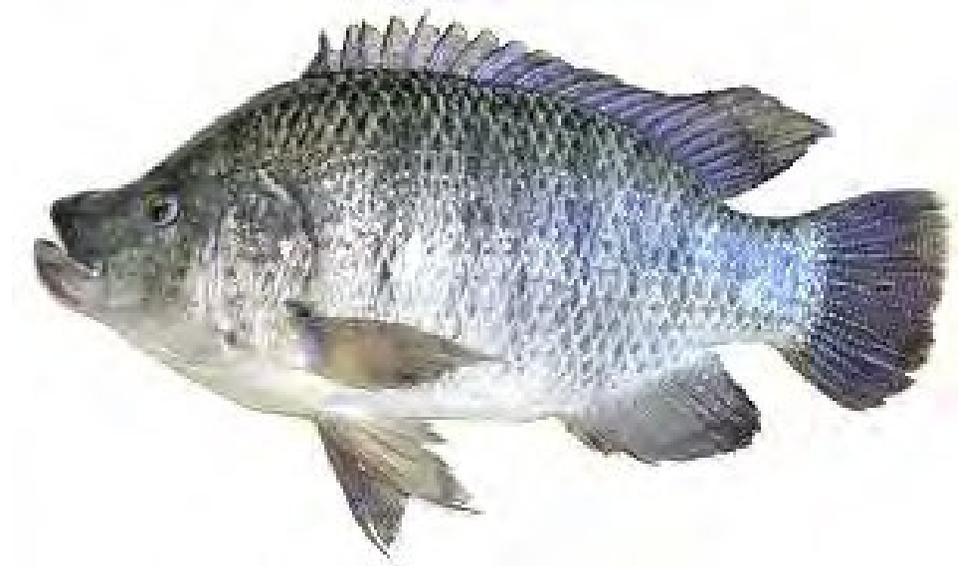
CASE STUDY 2

THE GENETIC IMPROVEMENT OF INDIGENOUS TILAPIA (OREOCHROMIS MOSSAMBICUS) IN SOUTHERN AFRICA

From 'super males' to 'super meals'

An aquaculture research project guided by Mr Danie Brink of the Department of Genetics at the Faculty of Agricultural Sciences, University of Stellenbosch

By Gerrit Loots



The Tilapia species (*Oreochromis Mossambicus*), a prime white meat fish source indigenous to Africa with huge potential to supplement the dwindling marine resources. Photo courtesy of the Aquastel website: <http://www.sun.ac.za/kie/unistel/aquaculture/aquastel/>

CONTENTS

Abbreviations	91
Glossary of terms	91
1 Introduction	95
2 The broader institutional context	95
2.1 The Faculty of Agricultural Sciences at the University of Stellenbosch	96
2.2 The Division of Aquaculture	96
2.3 The Department of Genetics	98
3 Key descriptors of the Tilapia project	99
3.1 Project history and context	99
3.2 Project objectives	102
3.3 Size and composition of the project team	104
3.4 Project funding	104
3.5 The project timeline	106
4 Mode of knowledge production	108
4.2 Research project dynamics	110
4.3 Project outputs, deliverables and dissemination strategies	111
5 The mode and contexts of knowledge utilisation	114
5.1 Intellectual property and commercialisation	115
5.2 Commercial utilisation by Aquastel	124
5.3 Utilisation for development	134
6 Concluding comments	144
6.1 Key observations and lessons learnt	145
Data sources	147
Face-to-face interviews	147
Telephonic interview	147
E-mail response to additional questions	147
Questionnaire	147
Publications and documents	147

Abbreviations

BCLF	Business Challenge Leadership Fund
CDC	Ceres Development Consultants
CIRD	Centre for Integrated Rural Development
CPPP	Community, Public Private Partnership programme
DFID	Department for International Development
IP	Intellectual property
NEPAD	New Partnership for African Development
NGO	Non-governmental organisation
OIP	Office for Intellectual Property
R&D	Research and Development
SADC	Southern African Development Community
SBLC	Stellenbosch Business Learning Centre
SFDP	Small-scale Fish Farming Development Programme
THRIP	Technological Human Resources for Industry Programme

Glossary of terms¹

- ◀ **Aquatic approach**
Approaching different research topics from an aquaculture perspective
- ◀ **Aquatic molecular genetics**
Genetic research on the molecular level within an aquaculture context
- ◀ **Brood stock**
Animals selected for breeding purposes
- ◀ **Collecting (eggs)**
Artificial collection of eggs from fertile females
- ◀ **Commercial hatchery**
A fish hatchery that specializes in the production of fry for supply/sales to on-growers/producers
- ◀ **Eggs**
Gamete produced by fertile females
- ◀ **Fingerling**
Small fish of the size range of 1-10grams
- ◀ **First generation products**
First generation of offspring obtain from selected brood stock
- ◀ **Fry**
Small fish as from the stage of hatching to a size of 1gram
- ◀ **Genetic diversity**
Refers to the genetic variation or differences that are observed between individual within a population, or populations within a species

¹ Two sources were used compiling the Glossary of Terms, namely Mr Danie Brink, Department of Genetics, University of Stellenbosch, and Walker 2000.

- ↳ **Genetic improvement**
Changes to the genetic make-up or genotype of the fish that will allow for enhance performance with regard to production traits
- ↳ **Genetic map(ping)**
The linking to genetic markers to specific areas of the chromosomes
- ↳ **Genetic marker**
Specific regions of the chromosomes that can be identified on the basis of unique DNA sequences
- ↳ **Genetic profile**
The genetic make-up of the fish
- ↳ **Genotypes**
Different genetic varieties of fish within a species
- ↳ **Hatchery**
A facility for the controlled breeding and propagation of fish
- ↳ **High resolution analysis**
Detailed analysis of the population structure of a species in terms of differentiation between and within populations
- ↳ **Husbandry**
The management practices required caring for the fish including housing, handling, feeding, etc.
- ↳ **Improved (genetic) strain**
Groups of fish with similar genetic and physical characteristics that display improved production performance
- ↳ **Molecular analysis**
Analysis of the genetic components on a molecular (DNA) level
- ↳ **Molecular genetic technologies**
Techniques that are used to investigate genetic components on a molecular (DNA) level
- ↳ **Molecular research component**
The aspect of the research project focussing on the molecular aspect of it
- ↳ **Multiplication**
The production or amplification of the number of fish of a particular genotype or strain
- ↳ **Natural biodiversity**
The number and types of species that occurs in natural ecosystems
- ↳ **Natural populations**
A population of a species in a raw (unmanipulated) state
- ↳ **Ova(um)**
An egg or egg cell
- ↳ **Phylo-genetics**
The evolutionary development or history of groups of organisms

- ◀ **Quantitative cycle**
The cycle whereby the data is verified
 - ◀ **Representative populations**
A population from the same geographical area representing the traits of the species
 - ◀ **Rotational fish farming**
Determined by difference in water temperature, more than one species is used in a full annual cycle of aquaculture
 - ◀ **Species**
A group of individuals that (1) actually or potentially interbreed with each other but not with other such groups, (2) show continuous morphological variation within the group but which is distinct from other such groups
 - ◀ **Strain**
A variant group within a species, often breeding true and maintained in culture or cultivation, with more or less distinct morphological, physiological or cultural characteristics.
 - ◀ **YY-males**
Male fish that contains two Y-chromosomes instead of the normal XY combination
-

1 Introduction

Feeding the nation in a sustainable way while conserving our natural resources remains a central challenge in South Africa today. Contributing to the national basket of food, the supply of a high quality fish protein is of great importance. The white fish marine resources in the South African coastal waters, however, have shown a steady decline during the last decade with the result that fishing companies began to look for alternative resources to supplement the marine source.

The challenge was to select the most appropriate African fish species to fill the gap in developing a local aquaculture industry. Such a species had to be genetically improved in order to take it to the level of commercial viability. Genetic manipulation as a means to reach the required commercial specification was not acceptable seen against the worldwide opposition towards genetically modified food. Therefore, research focusing on the genetic improvement of such a local species was deemed to be of critical importance. Such an improved species would be vital to establish the local aquaculture industry in a sustainable way.

The added benefit of developing the local aquaculture industry would be to use the same technology in the small farmer, food security context, namely by utilising the thousands of existing dams on farms in South Africa. Agriculture has shown to be central in the upliftment of poor communities and, in particular, their dietary requirements. Aquaculture, with the supply of a high quality protein to poor communities, held promising possibilities.

It was against this background and strategic need that Dr Danie Brink of the Department of Genetics at the University of Stellenbosch embarked upon the research programme of the genetic improvement of the Tilapia species. This species has shown itself to be the prime candidate to fill the gap of a local species that would be viable to replace marine resources. Financial support from the aquaculture industry contributed towards the launching of the project in 1992.

2 The broader institutional context

The institutional context of the research project is the Department of Genetics housed in the Faculty of Agricultural & Forestry Sciences at the University of Stellenbosch. The Division of Aquaculture is a virtual structure functioning under the auspices of the Faculty with the express aim of meeting aquaculture-related research needs. The Division addressed some of the commercial issues of the Tilapia project. The Office for Intellectual property serves the whole of the university with regard to the intellectual property issues in the process of commercialisation and, therefore aided the Tilapia technology by safeguarding the intellectual property. Two institutions that were established expressly with the aim of providing a context for commercialisation to academics and research outputs, include Unistel (Pty) Ltd and Aquastel (Pty) Ltd. Unistel operates as an institution-wide instrument while Aquastel, such as is the case with other spin-off companies in the Universities stable, has the particular brief of furthering the Tilapia technology in a commercial context. Each of these organisational contexts will be discussed in detail.

2.1 The Faculty of Agricultural Sciences at the University of Stellenbosch

The educational institution known today as the University of Stellenbosch was established on the 1st March 1866 as the Stellenbosch Gymnasium. In 1887 the name was changed to the Victoria College. The framework for the establishment of the University of Stellenbosch was put in place through the promulgation of law No. 13 of 1916, the so-called "Law of the University of Stellenbosch" (<http://www.sun.ac.za/>).

The Faculty of Agricultural Sciences, together with the other faculties (Arts, Natural Sciences, Teaching, Law, Music, etc.), was to be part of the new institution (Neethling & Swart 1968, 27) that would officially be launched on the 2nd April 1918. Although not *de facto* established from this date, the green light for the planning and establishment of the Faculty of Agriculture was already taken up in the statutes of the renamed University.

Today, being one of ten faculties at the University of Stellenbosch, the Faculty of Agricultural Sciences has an important role in terms of its teaching and research tasks. Measured by the overall number of student enrolments, it is the seventh biggest faculty (Feiteboek 2003). Student numbers remained relatively constant between 1998 (982) and 2003 (939), but declined in terms of the overall university enrolments (5.7% in 1998 dropped to 4.3% of total student population in 2003). The postgraduate component of students registering at the Faculty has, however, increased from 262 (26.7%) in 1998 to 300 (32%) in 2003. In terms of postgraduate enrolments, the faculty is the fifth largest at the university.

2.2 The Division of Aquaculture

The Division of Aquaculture at Stellenbosch University was established in 1989 with the aim to contribute to the development of the aquaculture industry of South Africa, through high standards of education and training, research and services. Aquaculture refers to the controlled production of aquatic species for human consumption and industrial use (Danie Brink, interview 10 September 2003).

The Division is a multi-disciplinary entity within the Faculty of Agriculture and, in some instances, expands beyond that into other Faculties, such as engineering, commerce and social science. It can be described as a virtual rather than a formal institutional structure. The Division does not aim to build specialised research capacity of its own. Instead, when particular research projects that are registered within the Division require specialised skills, the expertise is sourced from different departments. Once the project is concluded, people return to their original homes taking their new research capacity with them. This dynamic model of operation allows for the pooling of research resources without incurring high costs that a more permanent and formal structure would require.

The Department of Genetics is a core contributor to the activities and requirements of the Division in this regard. Genetics is one of five fields that operate within the Division (the others being Nutrition, Physiology, Ecology and Socio-economics). Other fields of research include Food Science, Economics and Conservation. Education & training programmes in aquaculture on offer include certificate courses and degree courses: BAgric, BSc, BScAgric majoring in Aquaculture; postgraduate courses: MPhil, MSc, PhD,

and Business Management. Some of these courses are also on offer on a distance education basis. Services include information, analysis of genetic material, feed, water, consultation and extension services; as well as the supply of equipment (transport, handling, grading) and products (feeds, ova, fingerlings). The Division is actively involved with a variety of species such as Trout, Tilapia, Abalone, Khoi, Carp and Catfish.²

The research group for aquatic resource development is one of the most prominent research groups within the Division of Aquaculture. From a strategic research management perspective within the Division, the dynamics and interdependence of the different research groups are managed in the sense that the highest value and benefit is sought. For instance, the research done by the research group on nutrition is structured in such a way that researchers would focus on the same species that the genetics research group is focussing upon. In selecting a particular species, the relevance and commercial viability to the commercial or the informal aquaculture sectors would be of decisive importance.

Research facilities operated by the Division include the Jonkershoek Research Station (previously operated by the Department of Nature Conservation) where rainbow Trout is the primary species focus. The hatchery where brood stock is kept and stripped has an anchor role in the operations. Although the hatchery is not used to capacity, it can be upgraded to 1 million ova per year. The main aim of the station at this stage is to develop best practice techniques for commercial farmers, and to provide supplementary ova on request. Another facility is the Welgevallen Warm water station. Here the focus is mainly on Tilapia species. The station consists of a temperature-controlled glasshouse and two tunnel systems. The glasshouse serves as the hatchery for breeding Tilapia and goldfish species.

The management of the Division is based on entrepreneurial principles. It is structured to deliver research outputs for specific needs. The staff structure and the responsibility for staff salaries demonstrate this fact: out of 24 staff members the University remunerates 2. The adverse effect of this arrangement is that the Division has a relatively high staff turnover because staff members often pursue careers in the industry. Seen from the perspective of broadening of networks, this is a good thing. But, from the perspective of research capacity building, it affects the Division in a negative way; in particular, postgraduate students often join industry before they have concluded their research projects (Danie Brink, interview 10 September 2003).

When the Division of Aquaculture was established, funding had to be found to support its vision. Funding from either a government source or the university was not available and so the Division engaged with industry. This eventually proved to be to the advantage of the Division because the particular needs of industry, or a commercial focus of the research activity, were decisive.

² Source: Division web page: <http://www.sun.ac.za/aasa/Services/Other/>

This also contributed to the establishment of wider networks within the aquaculture community.

You had this established network where you become a recognised partner with your full knowledge. So much so that, currently I'm chair person of the Aquaculture Association of Southern Africa [] the strategic value of that is having all this information and contacts flowing through your office where you can nurse your relationship with industry. (Danie Brink, interview, 10 September 2003)

Through the engagement of the Division with the Trout industry and private sector food companies, a well-established network with commercial companies developed. The Division acts on requests from industry (since 2002, via Aquastel³) for specialised consultancy. This consultancy work is not without its challenges. For instance, industry often needs advice in a much broader field than the highly specialised nature of researchers' knowledge, and only two or three members in the Division fit this profile. Another inhibiting factor is a practical one: the commercial partner has often paid for the initial research, therefore cannot be expected to pay for advice again. This is the reason why the Division does not put so much emphasis on consultancy work.

2.3 The Department of Genetics

The Department of Genetics is the home department of Mr Danie Brink, the project manager, and thus the academic context where the genetic research was done. It originated in 1925 from the Department of Plant Breeding in the Faculty of Agricultural Sciences. The Department is one of 15 departments within the Faculty. Each department offers a range of modules within one of the six instructional programmes, forming a specific specialisation field. The Department of Genetics has three legs, namely plant breeding, animal breeding and human genetics. However, much genetics-overlap-technology has relevance in other fields as well. Most of the projects originate from animal genetics. These projects place a strong emphasis on aquatic resource development. The research on Tilapia is probably the strongest research focus within the Department of Genetics (Danie Brink, interview 2003). It is the sole focus of animal genetics. From a strategic research planning perspective, care is taken that research projects support each other insofar as they have the same logic or focus. For instance, according to Mr Brink, if research is done on nutrition,

[] we make sure that it focuses on the same species that we are focusing on from the genetics perspective. And when we choose a species, we also make sure that it can deliver relevance to the commercial sector or informal sector. (Danie Brink, interview, 10 September 2003)

The strong aquatic approach to research in the Department of Genetics and the Division of Aquaculture stems from the fact that Mr Brink is managing both programmes. He emphasises, however, that research (by postgraduate students for instance) is not organised in a prescriptive manner, but from a perspective where students have the option to choose a research topic of their own choice and formulate their own thesis topics. They can also choose what species they want to do research on. Genetics focuses

³ For a more in-depth description on Aquastel, refer to Section 5.

primarily on three main aquatic species namely

- 1) Abalone (perlemoen), a marine species,⁴
- 2) Cold water Trout (which is a niche market in South Africa), and
- 3) Tilapia, an indigenous warm water species. Students have to master vital building blocks within genetics such as breeding and molecular biotechnology.

Within biotechnology, students can also choose a particular species from Abalone, Tilapia or Catfish. A particular research topic could then be selected within the species grouping.

The ratio between basic and applied research in the Department of Genetics is presently in the order of 1:9, according to Mr Brink. The industrial innovation of aquatic technology does not often present scope for basic research. Basic research requires a long process of often incremental advances and therefore a dedicated source of funding. It was the experience of researchers at the Department and the Division of Aquaculture that the capacity of, for instance, the National Research Foundation to fund basic research on a continuous basis, is very poor. Mr Brink explained this as follows:

You have ad hoc projects, but little continuity for basic research. Applied research, you can do much better on an ad hoc basis. You get involved in a project and deliver an outcome and start with the next one. Basic research is a long-term issue and we find that there's an under-supply in terms of funding. The outcome of basic research also requires a second stage of development before you can commercialise it. (Danie Brink, interview 10 September 2003)

By contrast, applied research has shorter research cycles and can therefore be undertaken with *ad hoc* funding and research capacity. With regard to the research needs of the local aquaculture industry, since it has been well-established over the last decade it is much more viable for researchers to focus on the transfer of technology than to get back to stage one by generating basic research.

With regard to consultancy, the Department of Genetics has only been involved to a limited degree. According to Mr Brink, with the growing commercial popularity of aquaculture, the demand for consultancy might increase. The level of engagement is determined by the activity within the aquaculture industry and requests for particular project involvement from the Division of Aquaculture. During periods of growth in an aquaculture business establishment, there is a greater need for the knowledge in the Department. Consultancy, however, impacts negatively on the human resource capacity of the Department because of the time-intensive nature of it.

3 Key descriptors of the Tilapia project

3.1 Project history and context

Traditionally, aquaculture in Africa was embedded in the context of the food security of rural communities. Aquaculture was not viewed as having any particular commercial value over and above supplying a readily available protein source to such communities.

⁴ Twenty-one companies operate commercial Abalone farms in the Western Cape.

Development agents working in Africa contributed towards these perceptions of the almost “low” value of indigenous fish resources. In addition, development initiatives in aquaculture seldom proved to be sustainable, and often collapsed as soon as the funding for projects ran out or the development agents withdrew (Danie Brink, interview 2003).

The commercial aquaculture industry in South and Southern Africa is extremely new: Mr Kriek Bekker described it as being in a “kindergarten” phase (Kriek Bekker, interview 2003). Only one significant aquaculture venture is currently in operation, namely that located at Lake Kariba in Zimbabwe. About 2000 tons of Tilapia is produced annually. It is a viable project and fresh Tilapia fillets are being flown out to European Union markets (specifically Britain) two or three times a week. Kriek Bekker described the situation as follows:

As such, there is no other serious commercial aquaculture venture on the species Tilapia up and running that gives us a history of how the things could be done. [] The fishing companies are now with us basically in an exploration phase, a development phase, the structuring of pilot projects to take us through [] And as such, it is big on risk. So there's no existing aquaculture ventures that they can buy into, the fishing companies. They can do it internationally in other continents in other parts of the world, but certainly not in Africa. (Kriek Bekker, interview, 17 September 2003).

One of the main reasons why the South African aquaculture industry has lagged behind is that, until very recently, marine resources were healthy. However this situation has changed:

We also see now the same effect of over-exploitation of our fishing resources. Our Hake industry is in serious trouble because of a lack of fish. The Pelagic fish industry was just the bottom end of the chain, the food chain of other fish species. We all know it is on the brink of total collapse. A first reason for focusing on an alternative is therefore an economic one. A second reason why more interest is evident is because the vital technology has now become available. Thirdly, we just lagged behind the rest of the world because aquaculture was never regarded as a strong agricultural option. (Kriek Bekker, interview, 17 September 2003)

In the years prior to 1992 (the date that the Tilapia project was registered), political isolation also brought isolation with regard to fish markets and aquatic research and technology internationally. This had a very negative impact on the Division of Aquaculture and its research vision. After 1992, things started changing with regard to the Division’s research goals:

After that, it really exposed us to many more things that were happening globally in aquaculture. That actually made us more critical about why we are not converting these resources and participating in the global industry. (Danie Brink, interview, 10 September 2003)

Performance indicators of the global aquaculture industry also contributed to the changing South and Southern African aquaculture scenario and perceptions about the commercial viability of aquaculture. This industry contributes about 30% to total food

fish production (36 million tons, net value of US\$52 billion, 1998). World aquaculture production has increased more than 40 percent over the last two decades, with aquaculture making up the difference between the rising demand and the stagnant supplies from capture fisheries. Africa is producing approximately 6% (570 000 tons) of the total world catch, with South Africa contributing 9% to Africa's and 0.5% to the total world catch, respectively.

Egypt produces 57% of Africa's aquaculture. Sub-Saharan Africa, in real terms, is almost non-existent in production terms, the reason being the lack of technology and infrastructure. South African aquaculture production, though limited in its contribution to Africa's and global production, has shown a significant increase over the past decade. Total production and value has increased from 3 000 tons (R51 million) in 1997 to 4 030 tons (R146 million) in 2000. This reflects an increase of 31% in weight and 35% in value from 1997 to 2000.⁵

A boom was starting to take place in aquaculture worldwide with the concomitant pressure on South African aquaculture to become part of this movement:

Because if you don't participate in establishing yourself during that boom period, you find it very hard to enter the market afterwards. (Danie Brink, interview, 10 September 2003)

Now it's for us to catch up with the rest of the world. (Kriek Bekker, interview, 10 September 2003)

Taking the context and heightened importance of an alternative white meat source into account, a particular need was identified for an indigenous species to be utilised for aquaculture development within South and Southern Africa. An assessment of aquaculture development globally indicated to Mr Danie Brink the improved value of the Tilapia species worldwide in the commercial aquaculture domain:

An indigenous species, indigenous to Africa, the Tilapia has elevated itself to the third most important aquaculture species in global terms. And yet, Africa was contributing only 9% of the global production of that species, and it shows how a species originating from Africa, has been transferred elsewhere and has been commercialised from low-level food security to top quality products in first world markets. And yet, Africa has again just been sitting and watching what was happening with its indigenous resources. (Danie Brink, interview, 10 September 2003)

Global marketing patterns also showed the heightened importance of Tilapia. A very high demand for white fish species developed due to the depletion and over-exploration of marine sources. Tilapia, being a white meat species, showed itself to be an ideal candidate to supplement the dwindling global marine and white fish resources.

⁵ Source: Aquaculture Association of South Africa (AASA) web site: <http://www.sun.ac.za/aasa>.

In Africa, two species commonly known as Tilapia fit this requirement: in the northern hemisphere the Nile Tilapia (*Oreochromis Niloticus*) and in the southern hemisphere the Mozambique Tilapia (*Oreochromis Mossambicus*).

As a white fish, very succulent, tasty, fine textured fish, the Tilapia is now becoming the alternative to Hake and Cod fish stocks. The normal fish and chips - the white fish of the world. So it has become a commodity product, not a niche product like Trout or Salmon or Caviar. (Kriek Bekker, interview, 17 September 2003)

The realisation that the almost urgent need for high quality white fish products on the world's markets are waiting to be serviced, contributed towards greater urgency for research and development of the Tilapia species. It introduced renewed and serious rethinking of what should be done to have the Southern African aquaculture industry participate in the global market, with a focus on adding value to local resources.

Mr Brink formulated the specific research project focussing on the genetic improvement and utilisation of Tilapia with the aim of involving the South and Southern African aquaculture industry in this context.

3.2 Project objectives

The primary focus of the Tilapia project was the genetic improvement of this white fish specie, with the aim of enhancing its commercial potential. Mr Danie Brink, the project leader defined the project goal as follows:

[] to enhance the genetic potential of the species to improve global competitiveness which is essential for South Africa (and Africa) to compete in the global market. (Danie Brink, interview, 10 September 2003)

The parameter for genetic improvement of the specie was drawn from the aspect of commercial viability and included traits such as shortened production cycle (i.e. weight increase), feed conversion and fillet quality. The broad rationale of the project was to bring about a change in a species that is regarded as having enormous commercial potential based on improvements in its genetic composition. More specifically, the research objectives was to produce so-called "YY-super males" (see Glossary), since such males can be used commercially to produce 100% male offspring with a better growth rate compared to females.

One of the first small-scale aquaculture projects on Trout and Tilapia started at Kromme Rhee experimental farm (under the management of Elsenburg Agricultural College) during the late 1980s, under the supervision of the Division of Aquaculture, University of Stellenbosch. Collaboration between Kromme Rhee and the Division is continuing.

Against the background of the Tilapia becoming a priority white fish food source globally, its status in Africa had to be assessed. To change the prominence of Tilapia in South and Southern Africa in aquaculture terms, strategic actions had to be taken.

The first important aspect that would have a decisive impact on the way the project would be drafted, was the domestication of the species. Although Africa is the natural home of

Tilapia, the species have not been domesticated or genetically improved. As a result, the African variety was inferior measured against the parameters of modern commercial aquaculture farming, such as growth, feed conversion, yield, meat quality, and so on. Therefore, the first challenge that would form the centre of the project was to improve its commercial viability.

This would, however, have the effect of reduced breeding potential. Natural breeding patterns of Tilapia did not favour a commercially viable aquaculture profile.

Tilapia is a precocious breeder. If you have them in mixed-sex ponds, you have a continuous contamination of the fish just breeding, they continuously breed. At a very early stage they become sexually mature and because it's a mouthbreeder, the female will carry the eggs in her mouth (as such they use the mouth as an incubator), she doesn't eat and she doesn't grow. After 21 days they spit the fry out and straightaway go back to breeding another cycle. So, you know, if you want to farm with them like we call in farming terms feed-lotting, you need to look at a mono-sex in your ponds. Preferably male fish because the male grows 20% faster than the female. And when you have an accumulation of male in your production ponds, there is no fighting like the males would fight over the female so there is no damage or cannibalism especially under the young fish. (Kriek Bekker, interview, 17 September 2003)

The second challenge to the research conceptualisation links with this male-preference in breeding based on the commercial reality that males mature earlier with better quality meat. A widely used practice in industry realising the all-male breeding goals, is hormonal sex reversal. At a very early stage, adding testosterone to feed would turn female fish into males. This approach was not acceptable from the Division's perspective, therefore another route had to be found.

The answer to the research question was clear: male dominance was the ideal in breeding methodology. A genetic breeding route focusing on a strain with very strong dominance of the Y-component was selected to be the preferred approach. The outcome would be all-male offspring that could be used as breeding source in feedlot ponds. A product that has the integrity of a true genetic protein source at a time of global consumer opposition against genetically manipulated food would be very valuable. Furthermore, if the base-line commercial aspects (fillet quality, taste, price, volumes, etc.) of the product are meeting market requirements, the product can be sold anywhere in the world.



A typical harvest result of genetically male tilapia GMT® (left) compared to mixed- sexed tilapia (right), under identical culture practices in pond trials in the Philippines. Notice the irregular size of the stocked fish and the presence of fingerlings in the mixed sex culture pond.

Source: Fishgen

3.3 Size and composition of the project team

Since the start of the programme in 1992, Mr Danie Brink has been the project leader. Two postgraduate students [Mr Paul Marais (MSc Agric) and Mr Edward Hall (MSc Agric genetics)] were involved, and Mr Louw Hofman (PhD meat scientist and nutritionist) made an input to aquaculture processing and food quality. From 1997, when funding from DFID (Department for International Development) was secured, researchers from the School of Biology at the University of Swansea (Wales) also became involved. These researchers were Drs Rupert Lewis (animal breeding), Eugenia Delmato and Graham Mair. Dr Philip Volkaert of the University of Leuven made important contributions in the area of advanced genetics, but was not really part of the research team. Various postgraduate students were involved temporarily at different levels in the project during its life span. From the developmental side, Mr Khalid Salie was appointed during 1995, but was not part of the research team as such. With the establishment of Aquastel in 2001, Mr Kriek Bekker became involved from the perspective of the commercialisation of the technology.

3.4 Project funding

Funding had a direct impact on the way that the research focus within the project developed. Initially, the project started out as a small in-house project with limited funding. Funding support came mainly from commercial companies that had an interest in extending the scope of aquaculture in South Africa, with the aim of developing the technology towards the support of marine resources. Through funding from industry partners ("... a consortium of commercial companies; some of them are also fairly small-scale operators, but it is the whole Tilapia-industry in Southern Africa who is benefiting from that..." (Danie Brink, interview, 10 September 2003) the project focus from the start

was mainly directed at the commercial utility of the research. Companies like Execufish, WPK Feeds and I&J supported the project. Although the developmental aspect was viewed to be important and formed a very specific part of the Division of Aquaculture's vision for aquaculture in South Africa, the resources were not available to focus on this aspect of transferring the technology.

The contact with researchers from the University of Wales at Swansea had a decisive impact on the research project, from both a research and a funding perspective. The University of Wales was an ideal partner for the project seeing that they had been operating successfully in Asia on aquaculture technology for almost a decade. Their experience in aquaculture technology transfer as well as in meeting the United Kingdom's DFID funding framework requirements, contributed towards the project research goals as well as securing funds for the Stellenbosch project.

DFID specifically allocate funds for the promotion of sustainable development and the elimination of world poverty. Through the contact with Swansea, the Stellenbosch project management was alerted to the DFID developmental support focus for projects meeting developmental criteria. A funding proposal was drafted and submitted that focussed specifically on extending the technology to the development and food security aspect. At the time of the DFID application, the food security aspect of the project was stagnant. Funds were secured from DFID with the result that the small farmer and developmental part of the project could be expanded.

In summary, the partnership with DFID strengthened the project from the poverty alleviation and food security side, while the partnership with industrial partners brought the needed momentum towards commercialisation. Mr Brink described the funding situation as follows:

[It was more difficult for the industrial partner to] mobilise their funds for non-profitable environments. DFID, on the other hand, was not keen to subsidise commercial research. And yet, the same technology that was applicable to the benefit to the commercial guys was also of benefit for the rural development programmes. So, that was actually a three-tier approach between a local research institution, the local industrial sector and an overseas development agent. (Danie Brink, interview, 10 September 2003)

[During] the intermediate, this DFID-phase, we actually relied on the external funding to mature the technology. What has happened now, we've built both capacity in the Division and we've released first generation products, and that has created a local awareness. So what we've done now, the project has amplified itself in size and scope and also at the level of applied technologies, and at the same time has converted it's funding basis to be reliant on a local source, which I think is very healthy. [] Even with the Innovation Fund, how it works, it compliments contributions from industry on a Rand to Rand basis, and it still recognise overseas contributions to that technology, also on a Rand to Rand basis. So it doesn't cut off the international link. It's actually strengthened that as well. (Danie Brink, interview, 10 September 2003)

Indirect funding was obtained from the University of Leuven in Belgium, which subsidised visits by South African students to the University.

Funding as an indicator of research recognition highlights, in this case, the growth of the research project. From an early start in 1992 with very limited initial funding, a 2003 project proposal for a five-year collaborative project extending the technology to other species, was approved by the Innovation Fund to the value of R15 million.

Table 1 provides an outline of the various funding institutions, what they funded and the value of the funding.

3.5 The project timeline

Table 2 provides a snapshot of the various stages of the Tilapia project between 1992 and 2003. A more detailed description of the research process and dynamics is provided in Section 4.2 below.

Table 1: International and local funding institutions

International funding institutions	Purpose	Year	Value (US\$)
The British High Commission (DFID)	Infrastructure Development	1997	8,000
Flemish Ministry, Belgium	Research & Development	1998	18,000
		2000	25,000
MJ Smith Trust	Staff, training, infrastructure	1999	50,000
National Research Foundation, S.A.	Research & Development	2000	150,000
DFID, U.K.	R&D and Training	2000	150,000
Depart. Of Economic Affairs, S.A.	Market Development	2001	15,000
US Aid	Research & Development	2002	25,000
Business Challenge Leadership Fund (BCLF) U.K.	Development: technology transfer to the rural sector (small farmers) - Aquastel	2002	120,000
Execufish			Unknown
Alnet (PTY) Ltd	R&D: product Development		R30, 000
WPK Agriculture Cooperative			R150, 000
Agrilek			R50, 000
THRIP	Innovation	1999	R2m +

Table 2: Project timeline

Period	Activities
1988	Project leader's first involvement with aquaculture
Prior 1992	Research and funding isolation; very low interest in aquaculture
1991	First aquaculture research project at Kromme Rhee (in collaboration with the University of Stellenbosch)
1992	Sent a student to international conference (Europe)
	First contact with Swansea/Whales research group
	Start of Tilapia project – first research cycle
1992/93	Constructing a genetic profile - laboratory based molecular analysis (18 month process)
1993/94	First contact with the Rural Foundation
	Quantitative assessment of biological performance of populations – breeding cycles (3 year process)
1995	First research outputs to industry: 1) a genetic label 2) a genetic map of the diversity within the species <i>Tilapia Oreochromis Mossambicus</i> 3) four strains identified according to superior production characteristics
	End of first research cycle
	Division starting to explore ways of using aquaculture and the Tilapia research in rural development
	Establishment of post: Development Officer
	Appointment of Khalid Salie as development officer
	Study on perceptions amongst rural populations on fresh water fish
1996	Start of second research cycle: The genetic improvement and YY-super male
1997 – 99	Rupert Lewis (Swansea) at Stellenbosch
1997	Start of Involvement of University of Swansea aquatic research group in project
	Securing DFID funding for project for developmental focus
1998	Start of collaboration with Leuven university (Philip Volkaert)
1999	Eugenia Delmato at Stellenbosch
2000	Request to the Office for Intellectual Property and Unistel for intellectual property safeguarding
	Start of involvement in drafting an aquaculture policy for South Africa

Table 2 Continued

Period	Activities
2001 (second semester)	Genetic breakthrough
2001	First YY males; start of process to provide fingerlings to aquaculture sector
	End of second research cycle
	Establishment of Aquastel (Pty) Ltd for the commercialisation of the Tilapia technology
2002	Signing of a Memorandum of Understanding between Division and Unistel
	Signing of a Memorandum of Understanding between Unistel and Aquastel
	Signing of a Memorandum of Understanding between Stellenbosch and Swansea
2003	Discussions between Aquastel and stakeholders: "Pushing back the frontiers of poverty" agri-village model
	Innovation Fund project transposing Tilapia technology to Abalone and Catfish

4 Mode of knowledge production

The project on the genetic improvement of Tilapia started in 1992, first as a small in-house project, and later as a larger project with overseas collaborators and complementary funding. Mr Brink described how the Stellenbosch group met the Swansea team in the early days:

Let me go back into my memory bank [] I'm not exactly sure of the year but I think it was in 1992 [], I had a MSc-student, Paul Marais, who was working on Tilapia on a limited scale. And I gave him an air ticket to attend the conference on Tilapia in California. And there he met with the Swansea-group that was reporting some of their research outputs at that conference. That was the very first [meeting], and it was just an inexperienced student that went to participate there. And from that this concept has grown. (Danie Brink, interview, 10 September 2003)

The collaboration with various research partners did not introduce any specific requirements from or inputs into the drafting or conceptualisation of the project. Mr Danie Brink at the Department of Genetics drafted the project in its entirety. Even the valuable collaboration with Swansea/Wales and the Department For International Development (DFID), did not introduce any particular research parameters or conceptualisation requirements on the project prior to the funding agreement, but rather contributed on the research process side, both in terms of the technical as well as the dissemination aspects.

According to Mr Danie Brink, the rationale, the energy towards drafting the research project, had to come from the research management at the Division of Aquaculture.

As collaborative partners they were very important. [] They had a lot of experience on the research side as well as with their dissemination strategies in Asia, although in Asia aquaculture is a part of their culture, the dissemination strategies there are less complicated than in Africa where aquaculture is not part of the rural culture as yet. But we've actually expanded our relationship on that basis; they are a good technology partner. (Danie Brink, interview, 10 September 2003)

The collaboration with the University of Swansea during the research process followed the pattern of the research cycles. During the first and initial phase, they were involved in a supervisory capacity on the molecular side through direct participation in the Tilapia project. An experienced researcher was seconded from the University of Whales to Stellenbosch to take up an important position in the lab. The researcher's brief was to supervise the molecular research component in order to establish local capacity and competency in that field. During the quantitative cycle, the collaboration with Whales was more on the advisory and supervisory levels.

The first researcher to visit Stellenbosch from Swansea was Dr Rupert Lewis, who remained with the Department of Genetics for two years. He was replaced by Dr Eugenia Delmato, a more junior researcher on a post-doc level. After two years, the local capacity was fairly well established and the post-doc built up superior experience in this field. She is still with the Department of Genetics and heads the research group.

On the vital aspect of establishing and building the necessary research capacity at Stellenbosch, the collaboration with the School of Biology at the University of Whales at Swansea proved to be of great importance. The expertise transferred from Swansea to Stellenbosch was in the areas of molecular genetics, a strictly laboratory-based research activity, and in the area of technology dissemination. The latter has to do with strategies whereby the technology is transferred to and hopefully accepted by rural communities:

The link with Whales- Swansea was a species link, and a technology link. We were working on the same species; a large component was technology transfer adaptation. (Danie Brink, interview, 10 September 2003)

The value of the collaboration with the University of Whales was therefore on various different levels:

- (i) building research capacity through their presence in Stellenbosch's laboratory and seconding their researchers (herewith also indirectly supporting the project financially),
- (ii) linking into their experience in aquatic technology transfer as well as supporting development through aquaculture, and
- (iii) in securing much needed DFID funding in order to expand the project to include food security and rural development.

Another important collaborative partnership was with the University of Leuven in Belgium. Their contribution was vital on the (more generic) aquatic molecular side:

[] another group led by Professor Philip Volckaert of the University of Leuven, who are very well positioned in terms of aquatic molecular genetics, particularly what we call phylo-genetics, that is the evolutionary development of species, and also high resolution analysis of genetic diversity. But those things are generic. Depending on what species you put inside the tube, it will determine what you get out on the other side. And we were successful in setting up a bi-lateral research programme with them, which meant that we could send particularly junior researchers to their lab for three to six months to pick up technical skills, as well as during the latter stages data-analysis skills from their group as well that stood us in very good stead. (Danie Brink, interview, 10 September 2003)

Where the DFID programme contributed funds, the Leuven programme covered the cost of Stellenbosch staff visits to their Leuven research facilities. The DFID funding as well as the research collaboration with Swansea and Leuven was vital in maturing the project.

4.2 Research project dynamics

The natural resource (the species) was available and the research team had full access to the biogenetic diversity of the species. The research process comprised different phases, namely the Tilapia sourcing, genetic mapping, and genetic improvement phases.

Throughout these phases, capacity building was vital and was supported through the collaborative links with Swansea and Leuven.

Because the programme is still in the phase of expansion, most of the first generation students are still in the project. Because they actually joined the project as honours and MSc students and they are now involved, the majority of them, as PhD level students. (Danie Brink, interview, 10 September 2003)

The first step was to source the natural populations of fish from the most northern location (the Chire river in Malawi) to the most southern location (Western Cape Region). The geographical areas of Malawi, Zimbabwe and Mozambique are represented by the Casanthule Tilapia strain. Towards the Limpopo basin, a particular species was identified, as well as for KwaZulu-Natal and the Eastern Cape. From this geographical spread, twelve representative populations were sampled.

Molecular genetic technologies were used to draw a so-called genetic profile:

It's like a family tree, what we call a genetic tree that, if you look at it, you can exactly see there what fits in and what is the genetic relationships. And then we back that up with a quantitative assessment of the biological performance of those strains or those populations. In other words, we compare their growth rate, their fillet yield, their food conversion, their survival rates, and so on. And then we picked the top four strains from these twelve locations. (Danie Brink, interview, 10 September 2003)

Genetic improvement is a long-term accumulative process. Some key inventions are made during the course of events but, as Mr Brink observed,

[] generally it's a slow methodical process, particularly now in our field of biotechnology, to make provision for short-term interventions that give you a kind of a surge in improvement. So the objective is a long-term one. We intend to work towards that long-term objective by more short-term projects. (Danie Brink, interview, 10 September 2003)

This first leg of the research process took about three years. The molecular analysis is a laboratory-based exercise with a short time span. The results of this process were ready within about 18 months. The quantitative assessment is an applied component, however, and was more complicated and time consuming:

There you literally have to breed the fish up in numbers and then do a comparative study. You go through the typical production cycle where you compare the fish. That is a fairly methodical and long-term process. So, after three years, we could present to industry a genetic label. After three years we also could present to them a genetic map of the genetic diversity within the species as well as four strains where we've identified superior production characteristics. So, that was the first phase of the project. (Danie Brink, interview, 10 September 2003)

The first three YY males were identified during the second semester of 2001.

4.3 Project outputs, deliverables and dissemination strategies

A wide array of research outputs was forthcoming during the course of the project. Although the specific aim of the project was to arrive at aquaculture technology linked to a specific species that would be commercially sustainable, research outputs fed into various academic and teaching activities at the Department of Genetics. Brink and colleagues also reported upon the project in journal articles and conference papers. The Table 3 below highlights the various outputs during the course of the project, and how these were disseminated. Selected project outputs are discussed in detail in the following sections.

Research papers at conferences and publications

Documentation on the research process took place on the level of scientific papers at conferences, articles in journals, conference proceedings, and so on. Technology delivery to end-users was mediated through a series of twelve workshops. In addition, short courses and one-to-one engagements were held with clients, prospective clients or current users of the technology.

Table 3: Project outputs and dissemination strategies

Project output	Status/time	Dissemination strategy
Molecular genetics technology	Concluded/ continuing	Teaching, postgraduate research
Research reports, academic papers, journal articles	Concluded/ continuing	Articles in Journals, conferences
Genetically Improved Tilapia strains made available to aquaculture industry	Second semester 2001 first 3 YY-males identified	“First choice” agreement between the Division, Unistel and Aquastel
Capacity building: Aquaculture industry	Continuing	Various workshops
Capacity building: Small farmer aquaculture	Continuing	Various workshops
Inputs to National Aquaculture Policy	Continuing	Regional and National Aquaculture workgroups

Teaching and postgraduate research supervision

Students were involved in various aspects of the research process. Mr Paul Marais played an important role in forging the research collaboration with the Swansea group, while others like Swart and Henrichson were more involved in the downstream dissemination and application of the technology. As was the case with Marais, Mr Edward Hall was also one of the first generation students.

In the process of research internships, students became knowledgeable in all the different aspects of the research process, either by visiting the University of Leuven or by the experience derived from Swansea researchers at Stellenbosch. Some of the students who were working on the project have since moved to European research units - one at Leuven and two at institutions in the United Kingdom.

The research also feeds into postgraduate (Masters and Doctoral) studies. At present, ten Masters and Doctoral students are busy with postgraduate studies.

Aquaculture policy

Since the beginning of 2002, a number of inputs into the first aquaculture policy for Southern Africa were made by the Division of Aquaculture. At the time, no country in Southern Africa had an aquaculture policy in place. Mr Brink, through involvement and motivation regarding the need and urgency of such a policy, initiated a process whereby regional workgroups started to convene to discuss an aquaculture policy:

We are participating in the Western [Cape] working group and in the Northern [Province] one. And we are also part of the National Steering Committee on Aquaculture. It is actually a problem to us, because we are basically a research group and we are getting bogged down in this developmental stuff, and it is difficult to abstain from it. If you don't take part, nothing happens. But it does impact negatively on your research. (Danie Brink, interview, 10 September 2003)

One of the cornerstones of these policies is the sustainable utilisation of resources. Obviously we are talking about an indigenous species, you can see the complications. It is far easier if a species is not indigenous. Then you bring in the exotic and you culture it and make sure it doesn't escape into the wild. Us, building an industry on indigenous resources, it's complicated, and we've made a lot of inputs. (Danie Brink, interview, 10 September 2003)

One of the key arguments made by Brink is that the natural biodiversity must be protected through such a policy, but at the same time, the development of new genotypes should be possible:

We said we want to keep that resource intact and not replace that with a narrow genetic resource. And so, our strategy is to keep that resource in the wild, taking from that resource, including that and the end product exported, is not contaminating the wild stock. And again, it becomes complicated if you have a well-managed, fenced off commercial farm, you can procure and secure these steps a lot easier, whilst if you disseminate into rural KwaZulu-Natal, virtually you sometimes lose control of what these people do with the fish, will they eat them, distribute them or release them or allow them to escape? (Danie Brink, interview, 10 September 2003)

Various declarations and regulations have been issued, and initiatives launched by the Food and Agricultural Organisation (FAO) from the United Nations, primarily because they were concerned about global biodiversity. According to Mr Danie Brink, these measures were often not implemented, particularly in developing countries.

So what we initiated was, from the ground-level upwards, we came forward with an initiative meeting this top-down approach, because sometimes [], particularly when they try and write these generic policy profiles, they sometimes just don't fit the unique circumstances in a particular country or a particular region. So we came forward with an approach from the bottom upwards meeting this top-down approach and blending the two initiatives into a much more workable and acceptable [form] because, the problem is, if your policies from top-down is not acceptable on the ground, it is very difficult to implement them. (Danie Brink, interview, 10 September 2003)

The acceptance of aquaculture as an important additional industry in agriculture by the national Department of Agriculture has grown considerably over the past ten years:

When I started off in 1988, I could only describe it as apathy and a complete lack, the word didn't even have definition. And then, particularly with the change of government, there were other social and economic, political priorities. We then went through a stage of a bit of negligence, I would say, and then the exposure, the similar thing that has happened to us in the early 1990's exposing us to Tilapia, was now happening to policy people and development agents, everyone is now aware of aquaculture, so from a position of a lack of knowledge and apathy through neglect and now to a state of slightly over-compensation. (Danie Brink, interview, 10 September 2003)

Aquastel was also involved in the process of drafting the national Aquaculture policy.

Environmental management and environmental legislation on aquaculture farming did not exist up to now. The problem is compounded taking the nine provinces into account. Each one has its own set of rules and regulations. No national aquaculture policy existed. (Kriek Bekker, interview, 17 September 2003)

Additional problems had to do with aquaculture policy that was lacking. No sector plans were in place, any strategies or statutory processes that could support new aquaculture applicants. No rules and regulations were in place to facilitate applications for commercial fish farming. According to Mr Kriek Bekker, Aquastel has, by its involvement as technology provider to industry, contributed largely to benchmarking aquaculture:

We have put down as a bench mark of what should be done in the aquaculture industry and Aquastel certainly has led the way in that regard which would now be regarded as a typical case, the bench mark case of how a fish farm should be applied for and constructed and operated. (Kriek Bekker, interview, 17 September 2003)

5 The mode and contexts of knowledge utilisation

Utilisation of the research outputs from the Tilapia project followed a primary commercialisation route, with an added focus on development. The fact that the research, from the start of the project, was earmarked for commercial utilisation, introduced obvious issues that had to be dealt with, of which the intellectual property aspect was probably the most important. Safeguarding new and further research outputs through the resources provided by the University of Stellenbosch's Office for Intellectual Property (OIP) showed to be vital for a well-structured commercialisation process. Three elements of the intellectual property framework form the core of the intellectual property safeguarding process:

- (1) the intellectual property policy of the University,
- (2) Unistel, the umbrella university-wide holding company, and
- (3) the establishment of Aquastel as a dedicated vehicle for the commercialisation drive of the Tilapia technology towards the fishing industry.

These institutional structures and their role in the commercialisation of the Tilapia technology are discussed in more depth in Sections 5.1 and 5.2.

Utilisation of the technology in a development context is managed on two levels, namely by the office of the development officer, established by the Division of Aquaculture (see 5.3) and by the commercialising body Aquastel described in 5.2. The development activities of these two bodies are not linked in any way apart from the fact that the Tilapia technology is central in both instances.

The Division's development focus managed by Mr Khalid Salie pursued the goal of building capacity in aquaculture amongst farm labourers in the Western Cape, while Aquastel (although primarily focussed on commercialisation), contributes to its developmental goal by designing contexts (see the agri-village concept discussed in Section 5.2) in which communities could be developed and capacity built. Aquastel's drive towards development

is still at an early stage (high level discussions with government and other interested parties and feasibility studies are still in process).

5.1 Intellectual property and commercialisation

Contextualisation: Intellectual property and the University of Stellenbosch

The operational structure to safeguard intellectual property and manage it towards commercial benefits both to the advantage of the university and the researcher(s), falls under the ambit of InnovUS (Innovation and Commercialisation), a management division responsible for technology transfer and the development of new business on campus. InnovUS investigates new disclosures of business opportunities and inventions, and serve as filter to commercialise the best ideas and initiatives in partnership with the inventors and entrepreneurs. Commercialisation is undertaken through a combination of licensing agreements and/or equity in spin-off companies after consultation with investors and potential investors in the new initiatives. InnovUS also serves as link in the network of teaching staff, entrepreneurs, mentors, investors and joint partners.

The Office for Intellectual Property (OIP) is responsible for the protection and commercial application of intellectual property (IP) which is developed by staff and students during the normal course of their work or study at the University. The OIP falls under the Office for Innovation (InnovUS).

The mandate of the OIP is managed in accordance with the Intellectual Property Policy of the University.

The OIP see itself as a player in the chain towards the commercialisation of knowledge products emanating from the institution. In other words, adding value to the fruits of the brain. (Jacques Stofberg, interview, 6 October 2003)

The so-called “fruits of the brain” could be patents, trademarks, copyrights and basic knowledge that is the result of knowledge outputs of academics. These “fruits” are packaged into intellectual property with the aim of sourcing markets for it through networks or contacts.

Fundamentally, the issue of dealing with the ownership of intellectual property at a public tertiary institution, largely funded by taxpayers’ money, has not been addressed in South Africa. In the United States, through the Bayh-Dole Act (1980), universities are forced to commercialise their findings within a particular period. If not, the United States government could claim the intellectual property. Mr Jacques Stofberg from the OIP described the approach at the University of Stellenbosch:

The University has certainly followed the route that America and the UK have gone, by claiming ownership and then sharing it with the researcher. We don't claim it for our benefit, we claim it and then participate in sharing it with the researcher. We do so on a generally favourable basis so as to incentivise it so as to come forth with some more findings. (Jacques Stofberg, interview, 6 October 2003)

The OIP works towards bridging the gap between the researcher and the commercial partner or consumer. The primary function of the OIP is the safeguarding (according to the Intellectual Property Policy, approved by council in 1999) of the intellectual property that the University owns. As soon as the intellectual property has been safeguarded by means of patents, trademarks, copyrights etc., the product is handed over to Unistel (Pty) Ltd, an extension and the commercial arm of the University.

From the side of the OIP, a specific protocol is followed:

Firstly to secure the intellectual property whoever is the legal owners thereof, and then, secondly to assist him in getting support from additional staff and/or members coming forth to fruition and/or our networks that was available to us, so, the intellectual property was then discovered to be jointly owned by Stellenbosch University and Swansea in Wales. And that then had to be safeguarded which it was, and other than that was this spin-off company that we formed called Aquastel, the intellectual property was then licensed exclusively to Aquastel. (Jacques Stofberg, interview, 6 October 2003)

Safeguarding intellectual property at an academic institution has very specific challenges. As Mr Stofberg pointed out, know-how is often one of the most difficult commodities to safeguard and exploit because it is human capital:

Human capital moves around (and) it can't be restricted. So, the best way to secure know-how and thus human capital, is to put it in a company and get those individuals involved in putting up a new company, developing processes and products. (Jacques Stofberg, interview, 6 October 2003)

Unistel Group Holdings (Pty) Ltd is a company wholly owned by Stellenbosch University. It was founded to exploit know-how (including intellectual property) arising out of research at the University. It provides opportunities for staff members and students of the University to commercialise intellectual property in conjunction with the Office for Intellectual Property, through a number of subsidiary and associate companies.⁶

The commercial exploitation of know-how, intellectual property and services of staff and students of the University is normally undertaken by any of the following routes:

- ◁ Establishing a spin-off company as an affiliate or associate company of Unistel Group Holdings (Pty) Ltd, which is a company wholly owned by Stellenbosch University;
- ◁ Outright sale by the OIP of the ownership rights of the relevant intellectual property to an outside customer;
- ◁ Licensing by the OIP of the exploitation rights to an outside customer; or
- ◁ The exploitation of intellectual property by means of an agreement with an outside customer in a joint venture.

⁶ Source: <http://www.sun.ac.za/kie/eng.htm>

Unistel Group Holdings has been used as a platform, in some instances, to launch new commercial arrangements. But the Group prefers to form a new company or joint venture or licence agreement. The risk factor must be kept to a minimum. An investment trust, set up by the University, would hold the equity shares of spin-off companies. Unistel facilitates the process. Currently, eight spin-off companies are operating under the umbrella of Unistel. Aquastel, one of the companies mentioned above, was established particularly for the commercialisation of the Tilapia technology⁷:

Unistel will take the business risks associated with new inventions, rather than the OIP who doesn't have any risks other than just paying for legal fees and legal costs and so, the OIP is really a unit at this university that's got a budget, an annual allocated budget, to spend, to safeguarding, whereas Unistel Group Holdings is the commercial company who doesn't really have a lot of funds to its disposal, but it would enter into negotiations and it would enter into contracts with various other role players. (Jacques Stofberg, interview, 6 October 2003)

Aquastel is also located under the office of Innovation at the University of Stellenbosch (InnovUS). It forms part of the commercialisation programme of the University looking at how to commercialise intellectual property that emanates from the academic environment. Three routes of commercialisation are possible. The first is that by way of royalties, commerce or industry further develops an idea or a discovery from the research environment, but the university/researcher gets royalties on the knowledge product. A second option is by selling the patent under specified guidelines, striking joint ventures where the university retains a portion of the equity as the technology partner. A third way is to keep it as an in-house company within the university and run it as a wholly owned subsidiary of the University. The model currently used by Aquastel is commercialising certain intellectual property flowing from the Division of Aquaculture:

Aquastel plays a mediating role between the aquaculture industry and the Division of Aquaculture, University of Stellenbosch. When the need arises for particular know-how, Aquastel as technology partner is contacted by a particular business and would then, in turn, structure the consultancy between members of the Division and industry. Managing consultancy need from this single interface contributes to concise control and safeguard that it does not get "out of hand" (Kriek Bekker, interview, 17 September 2003).

Commercialisation from a research perspective

The Tilapia research project had commercial utilisation as an end-goal from the start. The research and development of aquaculture technology linked to the species Tilapia, was believed to have high commercial value for South and Southern Africa. At the beginning of the project, while the focus was mainly on the research aspect, input from commercial partners was almost non-existent and mainly linked to funding. The commercial aquaculture sector was willing to fund a research concept that showed promise for

⁷ Other spin-off companies under the umbrella of Unistel are the following: Unistel Medical Laboratories, a commercialised Human Genetics Laboratory, the Centre for Automotive Engineering, prototyping and testing services to the Automotive Industry, Sun Space and Information Systems, a provider of high-performance systems and solutions to the international aerospace market, Unistel Technologies, CONSULTUS, EquipU4 Learning Systems and Sedation Medical Services.

commercial aquaculture. No specific requirements were expressed from the commercial players to the research unit in terms of research conceptualisation or delivery goals.

As the project developed and matured, and more parties became part of the project, such as both foreign and local research collaborators and NGOs, it became evident that the intellectual property issue was becoming an important aspect of future strategic planning and research direction:

What often happens is that the academic runs out of resources. Either from funding or from additional help or from assistance, and so, our office really comes to the fore as the support structure for academics to commercialise their findings. (Jacques Stofberg, interview, 6 October 2003)

From the side of the research management team, the growing complexity of the intra-collaborative nature of the project made it evident that more support from the University was vital.

Two things made us engage with Unistel as a support structure via the University. We realised that the technology research products has value and the value is increasing year by year, and we didn't have the experience and the capacity to manage them properly. We tend to undervalue them. We tend to engage in agreements which are not optimal in terms of benefits to the university, particularly to return funds to the Division. So when we went to Unistel and said, listen, what can you offer? So they've created a vehicle for us. First of all it was ad hoc arrangements with people that actually took up the research products. (Danie Brink, interview, 10 September 2003)

This realisation prompted Mr Brink to contact the Office for Intellectual Property for assistance. Added to this, the "snowball" nature of research outputs and the importance to include these into the intellectual property safety net as well, also contributed to the necessity to structure the intellectual property and commercialisation framework through the OIP. The intra-collaborative nature of the link between Aquastel and the commercial partners creates a dynamic of an ever-changing need for particular research outputs addressing practical aquaculture problems.

It was quite complicated because it's like a new model of a car every year, an updated model comes out. (Danie Brink, interview, 10 September 2003)

According to Mr Bekker, when commercialising intellectual property into industry, [] you have to be very knowledgeable about what the R&D and the development of the project encompasses. (Kriek Bekker, interview, 17 September 2003)

Not only the highly technical aspects are important (genetics) but also the mechanics of why particular intellectual property and technology will be successful must be understood.

People involved in the rolling out of the IP must be in sync with the research and development of the project. The flow of information from the research team through the commercial company (Aquastel) to the end-users will always have to be clear and open, because it's not a clean packed and sealed and done deal. It will ever be an ongoing R&D flow of information, because nothing is really hundred percent fully developed. (Kriek Bekker, interview, 17 September 2003)

Researchers often do not want to become involved in commercial activities; therefore alternative structures have to be formed.

Then you have to find alternative project managers like Kriek Bekker for instance with Aquastel, to come and help and assist and drive new initiatives. (Jacques Stofberg, interview, 6 October 2003)

Secrecy can be used as a method to safeguard intellectual property (Coca Cola is probably the best known example), while patents provide another route. In the case of patents, however, it only becomes feasible in cases where a clear commercial value is evident, generating an income of at least a R100 000 per annum. Then it becomes worth the effort and cost involved. One of the problems regarding intellectual property at the University of Stellenbosch is the fact that academics often do not value the results of their own findings in commercial terms.

I think, maybe the case is that they don't know that their research or invention is of particular value. Quite often they are just interested in doing the published article rather than getting any commercial benefit from it. They don't realise what it's worth. So, another task that the OIP has is to give training and awareness of what we do and what value products could hold potentially for the researcher, and then to disseminate that knowledge into the research community and put it out through workshops and presentations, etc. That's the only way. (Jacques Stofberg, interview, 6 October 2003)

Commercial viability is the defining element in evaluating research utilisation from the perspective of the OIP. The developmental aspect, although very important, is not part of the OIP's brief. The aspects of gender and race equality certainly are important to the OIP.

One of our driving aims is to find strategic partners of note and of value to all our companies. And although there are not many around, we certainly try and link up potential or emerging black empowerment groups through our initiatives. And we have identified a company called New Farmer's Development Company in general who also have a strong black empowerment arm and/or link to their businesses, and so, that's part and parcel of our continuous drive to find strategic partners. And through government's initiatives and government's requirements through legislation, it's important that we do find them for all of our projects. And Aquastel in particular is one area there are suited groups, and we had discussions with a number of influential black empowerment companies

on aquaculture. They do not have all the skills and the know-how, but we can certainly come together and form an alliance or partnership. (Jacques Stofberg, interview, 6 October 2003)

Linking this aspect specifically to commercial aquaculture via Aquastel has not yet generated positive results.

Safeguarding the Tilapia intellectual property

With the development of the Tilapia technology towards commercialisation, Mr Brink realised that the time had come to put a more formal structure in place to safeguard the intellectual property. Because of the intricate collaboration and funding structure of the research process, the OIP was approached to assist with the process of agreements and the setting up of the necessary structures to promote the commercialisation of the technology.

A memorandum of understanding was signed between the Division of Aquaculture and Whales / Swansea:

So we've reached an agreement with them, for them to foster the interest of the technology outside the SADC [Southern African Development Community] region, while we are dealing with the promotion of the technology inside the SADC region. [] we don't have the capacity to promote the technology globally, while they operate globally already, we came to an agreement that they will promote the technology on a global basis and we will concentrate within our capacity on a regional basis. (Danie Brink, interview, 10 September 2003)

An exclusive agreement between the Division of Aquaculture and Unistel whereby the latter was chosen to be the "first choice company" for commercialisation was signed. Unistel, again, by the nature of its focus and activities, seconded their rights regarding the aquaculture intellectual property to Aquastel. Other technological innovations from the Division regarding nutrition (AquaNutro), new genetic strains and aquaculture systems, are handled through these interdependent commercialising initiatives.

If we release an improved strain or a newer genetic marker, everyone that wants to use it must enter into an agreement with Aquastel [] the YY-males in their commercial hatchery, they stay our property, and the hatchery pay a licence fee for every fingerling produced from them to Aquastel coming back to the Division. (Danie Brink, interview, 10 September 2003)

An agreement was entered into between the Division and Aquastel to address future needs for continued aquaculture research as would be required by commercial companies.

It's an arrangement that when they require services they contract it to us. (Danie Brink, interview, 10 September 2003)

The University is currently the hundred percent shareholder of Aquastel and it will remain so until such time that additional partners or shareholders of strategic importance to the company and the aims thereof are found. At such a stage, a strategic decision regarding further operationalisation and capitalisation will have to be taken in order to stimulate

further growth. Negotiations are being considered regarding how to steer between the various alternatives that different strategic partners might offer.

Currently, no advice or requests in terms of preferential research based on commercialisation potential are communicated to departments or researchers by the OIP

Unfortunately the answer is no, we don't have a direct input insofar as new research is concerned. I think we are getting to be driven by the actions of the academic. And suggestions for alternative ways of doing things, either in terms of know-how or need processes, would come from the academic in 99% of the cases. We see ourselves only focussing on the commercial potential of the current inventions, and then, should the academic come forth with new ideas and/or new IP; we would assist in that as well. We much prefer a bundle of technologies to be leaders in particular market segments. (Jacques Stofberg, interview, 6 October 2003)

The Tilapia technology and related technologies are certainly viewed as such a “bundle”. The reason, from an intellectual property perspective, to focus on technology bundles is mainly to extend the life span of the intellectual property.

The value of IP only really lies in its ability to confer a competitive advantage on the legal owners thereof. For the advantage to be competitive, you need to have it maintained over a period. Most often, the best IP would only give you that edge over a number of years although the patent is worth for 20 years. In reality it doesn't really last that long. (Jacques Stofberg, interview, 6 October 2003)

The value of the involvement of the OIP lies in facilitating research at a stage that very few people are interested in investing in it.

We really become involved in that pre-innovation, pre-incubation, early early stage of the technology. That's really the area that no one else is prepared to take any risks or put any money onto it. (Jacques Stofberg, interview, 6 October 2003)

The support from the OIP and Unistel is viewed by the research team as having been of vital importance for the process from research to commercialisation.

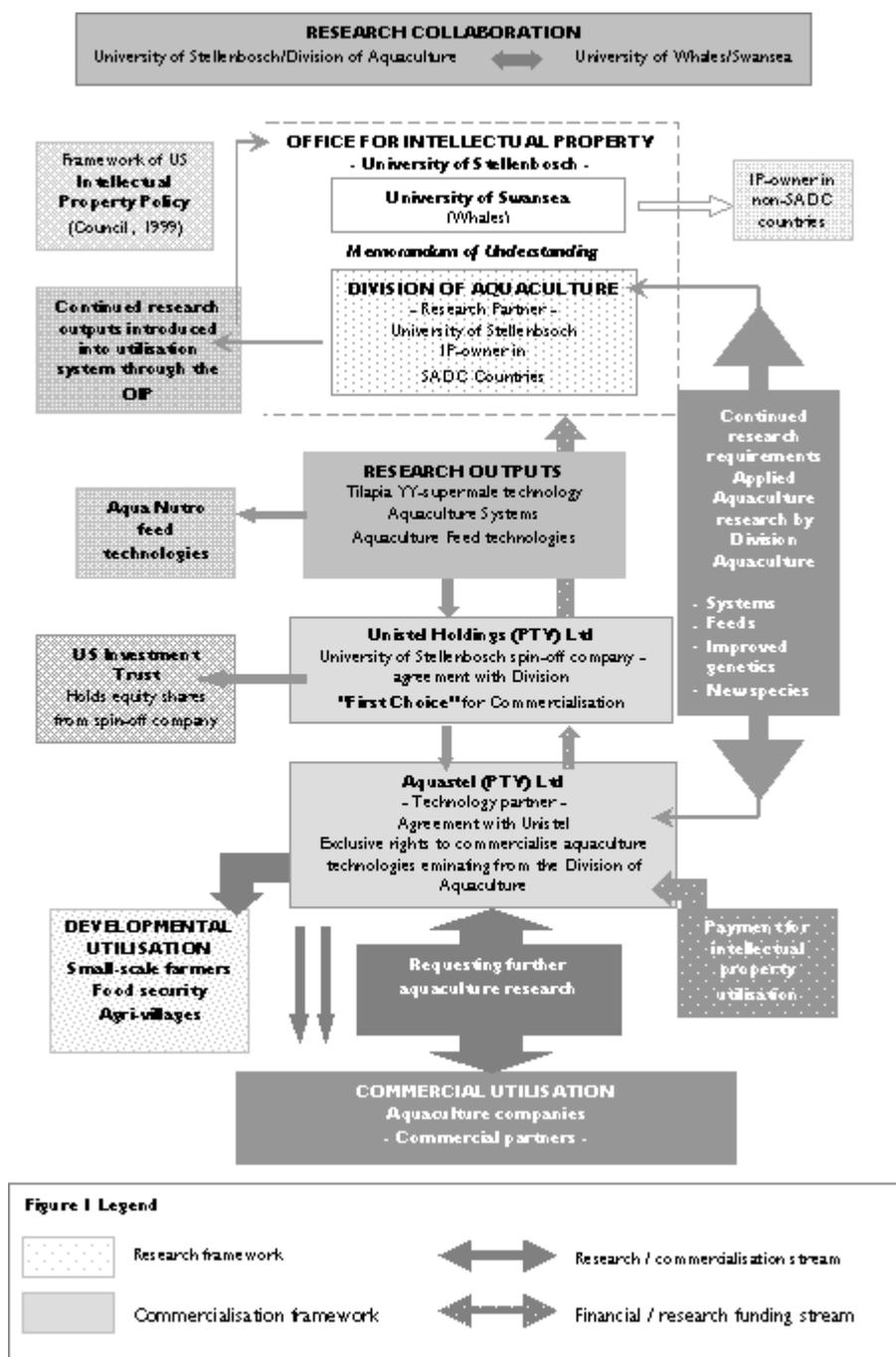
They've given us a lot of support. It is complicated, because we find the industry, for example the fishing industry, and try to get recognition for IP in terms of converting intellectual property into equity. You know, that is very difficult. They've never heard of it or never done that before. They've never recognised it. In the past they've just taken the chequebook out and paid for everything that they wanted. And suddenly we say, but no, this is underselling the value of the technology. So it was hard. And also for us as researchers, you become dependent on these industrial funding agents, and you often have a lack of confidence when you have to convert the research output [] and we've just found it's working a lot better in working through Unistel. They can play hardball far better than us. (Danie Brink, interview, 10 September 2003)

Intellectual property/commercialisation structure of the Tilapia project

The dynamic of the research to commercialisation flow of the Tilapia technology is depicted in Figure 1:

- (1) The Office for Intellectual Property has a central function in the safeguarding and spin-off of the Tilapia intellectual property. It provided the intellectual property framework in which agreements of understanding were drawn up between different partners as well as the structure through which the technology would be made available for commercial purposes.
- (2) The research outputs, such as the YY-super male technology and additional aquaculture technologies (aquaculture farming systems, feed technologies), are made available to Unistel Group Holdings (Pty) Ltd on a “first choice” agreement basis. The equity shares in Unistel are held by the University of Stellenbosch investment trust.
- (3) Aquastel, as the commercialising company, received the exclusive rights to the technology from Unistel. Aquastel commercialises various related aspects of the Tilapia technology. These include the Tilapia YY-fry and fingerlings and a whole array of services for prospective aquaculture farmers such as feasibility studies, financial and budgetary advice, aquaculture management services, etc.
- (4) Commercial companies buy the fingerlings from Aquastel and consult the Division of Aquaculture via Aquastel in cases where new research and development is required.
- (5) The Division acts upon the research requests from the aquaculture industry, and channel the research outputs into the same commercialising stream via the OIP. This dynamic of research, utilisation and research, ensures the continued delivery of new aquaculture technologies to the industry and serves as a quality check on the research done at the Division.
- (6) Payment for the technology flows from the commercial companies via Aquastel and Unistel to the Division and is an important source to fund further research.

Figure 1: The dynamics of research to collaboration



5.2 Commercial utilisation by Aquastel

The first cycle of the research project was critical and focused mainly on delivering the first generation of products, either commercial packages or new strains of fish ready for supply to the aquaculture industry, both formal and informal. The genetic breakthrough (second semester 2001) enabled the Division for the first time to enter the commercial aquaculture sphere supplying fingerlings to the industry.

Transferring the Tilapia technology to the commercial domain in order to contribute towards the development of a robust aquaculture industry in South Africa was a primary objective within the research project's utilisation logic from early on. Mr Brink described this as follows:

Our first priority is to establish a viable commercial entity, from there then the opportunities through Small Medium Enterprises service provision and eventually food security flows from that centre to the adjacent communities. But for us, having limited human resource capacity, it is easier for us to work with one commercial unit and these secondary benefits although there is a time lapse, than trying to mobilise the human resources because we, the outside geographical zone where you want to achieve food security, it is a high cost, you know, to develop skills and awareness, and to get that project into operation is very expensive, if you are just thinking of the human resources, so we said, let's focus our resources and see if we can get this commercial core going, and with the clear objective from that, that axel, to make sure that the skills and technology gets diluted to the surrounding communities. (Danie Brink, interview, 10 September 2003)

This was a strategic choice because of human resource constraints in the Division. The commercial incentive, it was believed, would provide the stimulus for the necessary developmental expansion as soon as the technology proved its commercial viability: first the commercial success and consequently the establishment in the developmental and food security spheres.

In a certain sense, this methodology presented itself through the way in which the private commercial companies became involved with the Division and the particular research project from the start. Funding towards promoting and establishing the Division's vision after its inception could not be secured from the University or government funding, with the result that the early involvement of commercial partners proved to be essential to the future development of the Division's goals. This commercial link was also transferred to the 1992 Tilapia research project where the research management had a mostly informal collaboration with the commercial partners, with the result that no particular outcomes were formulated in terms of the research conceptualisation or specific project outputs from the side of the commercial companies.

With the fruition of the first phase of the research project and the availability of the first generation ova and fingerlings, necessity stimulated the establishment of Aquastel in 2001 as a commercial spin-off company of Unistel. The YY-super male technology was then routed towards the commercial aquaculture community through Aquastel.

Aquastel is a registered company with close links to the Division of Aquaculture. *We're a Pty Ltd company, but we're none other than a commercial front-company for the Division of Aquaculture. So, what happens, as an academic environment, they can't go out and facilitate commercial project management and deal structuring and co-managing and running of entities. We do it on their behalf. But in principle, as they are individually and through the university, co-owners of Aquastel, it can be called participants in Aquastel, you see the commercial benefits flowing back to them. And certainly one of the objectives is to have some of those funds or benefits coming back into the R&D environment. (Kriek Bekker, interview, 17 September 2003)*

The aim of Aquastel is defined as

[] to establish a viable commercial aquaculture fish industry in Southern Africa with the Tilapia species O. Mossambicus by using all natural, human, scientific and financial resources to the total benefit of this region and all it's people. (<http://www.sun.ac.za/kie/unistel/aquaculture/aquastel/>).

The commercial implementation of research outputs is channelled mainly (up to 70%) through Aquastel. In the case where Aquastel cannot meet all needs, the Division will supply to Aquastel. Previously the Division produced fingerlings but this has been taken over by Aquastel. Advice on production management systems is sourced from the Division via Aquastel. The Division develops the improved genetic strain, while Aquastel does the multiplication and the supply to industry. Aquastel at various locations in the country is setting up satellite structures. In KwaZulu-Natal a hatchery was developed. A hatchery is also under development in Mpumalanga. Support to that region comes from the infrastructural capacity of the Division, but is reflected in the financial statements of Aquastel (Danie Brink, interview 2003).

The working relationship between Aquastel and the Division is mutually beneficial. No input into the conceptualisation of the 1992 research project was made from the side of Aquastel because the company had only been in existence for just more than two years at the time. Aquastel did, however, make valuable inputs into the research design and Innovation Fund application of 2003. R15 million was approved for the expansion of the project.

Research and development

Continued research and development showed to be of major importance to the aquaculture industry. Specific technology needs are identified by industry and communicated to Aquastel. Aquastel, in turn, lodge the request for the research with the Division of Aquaculture. It is particularly at the level of aquaculture farming systems methodology that a big need for continued research is experienced. Aspects such as the size of ponds and water quality management, feed quality, the management of diseases, etc. are of important. It is through the interaction between researchers and the aquaculture industry that a “hands on” systems development can take place.

Certainly the academics add certain valuable technology components to the deliverance of these systems, but they cannot build systems. Commercial companies build systems externally. Their inputs in partnership with the academics, results in a deliverable package, something that is very well done, defined and applicable that can be sold commercially.

Now the commercial people are coming to the table, deals are now being tied up whereby they would put certain money in to develop the thing right through all the phases and different commercial roll-outs. What we do is certainly to supply the technology. We are not fish-farmers. And we are not financiers. But some of that money, yes, will flow back into research and R&D. (Kriek Bekker, interview, 17 September 2003)

Commercial companies are aware of the benefit to them to have the aquaculture research capacity established locally. Although they are mainly concerned with the commercial value of the final product, they might in future also invest in developing the product through increased funding of genetics and food conversion research. The option to invest R&D money in Aquastel is a viable one for industry because of the backing by the Division of Aquaculture and the University of Stellenbosch.

To buy the technology from overseas to be applied in a local context is not feasible for companies wanting to invest in aquaculture. They prefer working with local tertiary institutions. [] Very positive signs are there that we are catching up. (Kriek Bekker, interview, 17 September 2003)

The close working relationship between the research team and Aquastel contributes towards the high value that is placed on the practical applicability of the research. It is Aquastel's close contact with the aquaculture industry that provides the answers to the question, "... does it have a commercial interest and a value to the industry out there?" (Kriek Bekker, interview, 17 September 2003).

Aquastel offers a whole range of expertise and services to the aquaculture industry. Other species (Abalone and Catfish) are going to be included in future research. Different farming systems are being developed. Consultation services are rendered to clients:

[] environmental management plans, environmental audits, the drawing up of business plans, the doing of feasibility studies, viability studies which is part of all this documentation that is necessary for the pre rollout of the commercial project. Now, that type of service we either supply ourselves or we are consulting people who support us in supplying that. [] not only are we facilitating the technology surrounding the genetics of this Tilapia species, but specifically also covering a whole field of aquaculture all encompassed under the umbrella of technology which could be the biology of this whole aspect like disease, feed, feed optimisation, the rolling out of students who can act as site-managers in aquaculture, project managers, the issue pertaining to different systems of farming with fish, water management, water control, environmental issues, so, we created a company who could deliver a total package to the industry out there. (Kriek Bekker, interview, 17 September 2003)

Features of commercialisation

Good genetic breeding material for commercial multiplication (YY-males and females) is supplied to Aquastel from the Division for multiplication purposes. Due to the problem of transporting fingerlings, Aquastel had to establish regional hatcheries in KwaZulu-Natal. The process of establishing further hatcheries at strategically important areas such as Mpumalanga is under way. The parental brood stock originating from Stellenbosch is placed in these hatcheries with the sole purpose of multiplication. Three main strains of fish have been selected from Malawi to Verlorenvlei in the Western Cape. These strains are the Ndumo, Kasanthulo and Olifants, because they showed the best genetic growth potential. One of the early obstacles that had to be overcome was the relocation of a strain into areas foreign to the original habitat. This problem was solved after workshops between the research team and stakeholders (Department of Agriculture and Water Affairs) were held to explain that the brood fish are of such limited numbers that they hold no environmental danger to the indigenous strains.

These are also not engineered fish but genetically modified. If one of the fish would escape, it is nothing different from what is there in any case. (Kriek Bekker, interview, 17 September 2003)

The business plans of the commercial utilisation of Tilapia and its viability were based on earnings and profit margins accrued through export markets. Because of the quality expected at international markets, production costs will also be higher; therefore local markets will probably not be a first option. In order to ascertain the acceptance of the product, market research had to be done. Trial batches of Tilapia had been processed and sent to first world clients in the European Union, from which the research team received a positive response.

The intellectual property was made available to commercial partners. Some of the big fishing companies were already extending their business into aquaculture. There are indications that more companies will become part of the aquaculture industry and make use of Aquastel's services. Some financing institutions might consider entering this industry with Aquastel as technology partner.

Supplying brood stock

The brood stocks in regional hatcheries serve as basis for multiplication. Progeny from the brood stock is managed to reach critical mass after which they become available for commercial purposes. They are then supplied on demand to commercial companies in the aquaculture industry. The Division receives royalties on the sales of the fingerlings, and supports the further expansion of the Tilapia fingerlings towards commercial viability.

They back the whole operation with all the technology they have. Breeding, genetics (when to do what) collecting eggs, how to hatch, treat little fry, water quality, husbandry, diseases, etc. The Division will retain ownership of the brood stock sitting in someone else's hatchery. Certain checks and balances are being put in place to safeguard the property. The income is derived from the commercial multiplication of the progeny. Also consultancy work that is supplied on a cost per request type. (Kriek Bekker, interview, 17 September 2003)

Species-specific parameters for new ventures

An important part of the business planning support provided by Aquastel is to determine the feasibility of a new aquaculture venture. The specie-specific requirements are decisive in this regard: Tilapia prefers a stable and optimum water temperature of between 24 and 32 degrees centigrade all year round. Only the warmer parts of southern Africa qualify for open pond low cost systems. Therefore the focus was on Northern Zululand, certain areas in the Lowveld of Mpumalanga, Mozambique, the higher northern part of Limpopo province, Zimbabwe, Zambia, Malawi, Botswana, Namibia and Angola. These areas have the resources in terms of land, water, and people interested in low-cost, open pond production systems. Three cage-culture operations are presently being launched on big lakes and reservoirs, they are currently at different stages of statutory approval and implementation. A pilot project is running in semi-intensive earth ponds in Zululand in partnership with local communities.

Where the temperature is not ideal, the option of a more capital-intensive system is still possible. In this case a farming system would consist of an indoor temperature controlled full re-circulated system. Although this is more capital intensive, the return on investment normally is better than the open pond system because of better control and product quality. Regarding optimum energy utilisation, studies show that heat-generating operations are available in forms not often considered. These are, for instance, heat-generated by boilers, flu gas or methane gas as well as landfills where methane gas is produced. Heat generation from cool room facilities and warm water coming from underground at mines, could also be utilised. Numerous examples show that operations where heat is generated could be used for setting up farming systems in the proximity (Sasol, petro-chemical companies, refineries). The rethinking of collaboration between industry and aquaculture implies that community projects can be launched as part of the public responsibility and affirmative action drives of companies.

Aquastel had been in operation for about two years, investigating the best collaborative options for commercialising the technology. An innovative approach whereby all possible options for the establishment of aquaculture ventures are evaluated is followed. Such options could include big companies with under-utilised infrastructure and a demonstrated need for social involvement.

Aquastel methodology

Aquastel's main aim is to sell its YY supermale technology to aquaculture businesses. In order to grow that market, it has made a strategic decision to be involved in all the aspects of establishing such businesses and render related services on a consultancy basis. In order to stimulate new aquaculture business ventures, Aquastel follows a particular methodology. Prospective clients often approach Aquastel to assist in various areas of establishing an aquaculture business.

These include aspects such as site selection, the drafting of a business plan, the sourcing of finance, the establishment of infrastructure, the introduction of aquaculture management plans, the training of staff, etc.

Ideally someone owning the land (private or government), a partner coming in with the venture capital (a fishing company or purely an investor) and Aquastel as technology partner, would get together getting an aquaculture venture going. (Kriek Bekker, interview, 17 September 2003)

Technical advice, however, remains the primary focus of Aquastel. It includes the following: the monitoring of water temperature through a 12-month cycle, including water quality, and the species in the particular system. Feed conversion is a very important aspect because it comprises 62% of operational expenditure and should therefore be optimal. The feed conversion rate from feeding to biomass determines the bottom line viability.

So what we do, we test feed, we test feed conversion, we test the species, we test the temperature parameters, water control, water management, ourselves in terms of project management. All this is then thrown into a business plan, which is drawn up in advance, and then this specific geographical area, which, in our terminology is called a "node", is tested through a pilot phase. Once everything clicks, your investor, your partners pull out the chequebook and they start looking at serious investment. Scaling it up, in commercial roll-up in phases, which we can handle and can manage according to our own capacity, taking us up to that critical level of what we call an economy of scale. (Kriek Bekker, interview, 17 September 2003)

Potential areas of collaboration regarding in-door temperature controlled fully circulated systems are being investigated. Companies with under-utilised production capacity and spare boiler energy capacity (fishing and canning companies and factories) are being identified. This would enhance South Africa's export abilities.

The total world consumption of Tilapia at this point in time is astronomical. And in terms of America and Europe, fish supplied from importers by Asia and South America to a certain extent the islands in South-East Asia. Africa is never really in contention as a serious supplier to the industry in first world countries. So what is happening now, we are really starting up our industry. (Kriek Bekker, interview, 17 September 2003)

These areas of business development are presently Aquastel's primary focus of expanding the utilisation of the YY technology. The process to establish the technology in the aquaculture industry does not happen overnight, but will take planning and an innovative marketing approach.

It is not there yet, and certainly, as I have indicated, we are still in the implementation and development phase. Two years down the road from here, certainly we will have commercial projects up and running that has absolutely completed that topic in terms of the goal posts that we want to hit. But it is an ongoing process. Particularly the process of skilling people on different levels of the project requires time. This is an ongoing process. Personally I think that topic is going to be in the region of a five to eight year plan. (Kriek Bekker, interview, 17 September 2003)

Regional workshops have been used by Aquastel as one of the most effective instruments of exhibiting and explaining the technology. They are also found to be the optimal way to transfer the technology to interested parties in the commercial aquaculture sector.

Mr Brink described these workshops as follows:

The workshop normally is an open workshop, but we made sure that specific people would attend it. That has really worked very well. Particularly long distance engagements, that was a very good strategy for us. These workshops with industry often were linked to sessions who were attended by (research) colleagues in the field. (Danie Brink, interview, 10 September 2003)

The relationship between the research Division and the commercial users has crystallised into more clearly defined boundaries than that which existed in the beginning of the process. The commercial aquaculture companies want to develop and manage certain aspects of the business to such a level that they are self-sufficient. In other aspects, they clearly do not want to invest resources but would prefer the Division of Aquaculture to supply those.

There are certain technologies where the commercial people like to keep clean house. For example how to breed the fish, how to process the fish and add value, they like to keep that in their businesses. But their two main problems of genetics is difficult for them. They cannot run a molecular lab and a biotechnology lab, so this is a contractual arrangement that works very well for us. So, we have become a genetic one-stop-shop for contractual research and they know exactly what is our initial objective. We want to be and now expanding our scope where the initial focus was on the Trout industry in South Africa, we now are focusing on the South African Aquaculture sector. (Danie Brink, interview, 10 September 2003)

Impact on the research process from the commercial side

The research project started in 1992 with a small budget and preliminary project definition, focussing on one species only. It has since expanded into a large and dynamic research project with a broad research focus, multiple funders and collaboration on various levels. The latest (2003) Innovation Fund allocation of R15 million has the brief to expand the project and extend the Tilapia technology to Abalone and Catfish. Many of the original funders and collaborators (about 60%) are continuing their links with the project, while many new funding and collaborating partners have joined the project.

The commercial value of the first project's research outputs was demonstrated through the mediation of the OIP and commercialisation inputs from Aquastel, and will be continued through the interdependence of the research team, the commercial company driving commercialisation and the industrial partners.

We will be reaping the benefits of that. Collaterally it is called for the commercial partners involved in those three species in that Fund which is Abalone, Catfish and Tilapia, will find their own sources of funding to contribute on a one-to-one basis to what the Funds contributes. And that is specifically focused on certain key-component areas of ongoing research on these species. In the case of Tilapia, it involves

certain definitely more genetic work, and it also involves the better domestication with the current local species that we're involved in. (Kriek Bekker, interview, 17 September 2003)

During the conceptualising of the first project, Aquastel did not exist and, therefore, did not contribute while in the most recent project (2003) their input was more substantial.

Yes, certainly we had, to the extent that it was discussed with us, we particularly were comfortable with the goals and aims of the specific fund. We certainly also made a commitment to find, if we can't come up with it ourselves, find co-hosts, co-funders to address in a unilateral or collateral way the funding of this process. [] coming in from the field, coming in from a commercial application, Aquastel via it's commercial partners, would bring certain topics to the researcher, and say, [] we will co-contribute or maybe at least make some input in what we would like to see which direction researchers would focus in future to make it more commercially interesting to us. And already, I can see signs of that coming through, and I think one area that is maybe lacking, is that we would like more systems tested. Systems for farming fish in. You know, there are aspects like stocking density, until what point (do you stock) before they will crash. That type of R&D work on the systems of farming aquaculture is another completely different angle whereby universities should get involved or this Division should get involved and doing it on our behalf. And certainly, in the field of feeds, better feeds, better feed optimisation. (Kriek Bekker, interview, 17 September 2003)

As soon as the results of the research were being disseminated into the industry, Mr Danie Brink was approached by other commercial sectors who saw the applicability of the research to other species. The Abalone and Catfish sectors were very interested in what the research could contribute towards value adding. The request was put to the Department to simulate the same strategy for application to those species.

Because everyone realises that to be globally competitive, genetic material must be as competitive as your management and husbandry technologies. For input costs, so you know, in a very quick period of time, we have actually exhausted our capacity, we actually have been warned or criticised by certain groups to be careful not to overextend our capacity. (Danie Brink, interview, 10 September 2003)

Commercialisation: Other spin-offs⁸

Research in the Division was instrumental in developing AquaNutro, a company specialising in the research and manufacturing of aquaculture feeds. Mr Bekker explains the value for the aquaculture industry

It is important to us that AquaNutro as the current, really the only sort of quality producer of aquaculture feeds in South Africa should have all the support and backing of everybody involved in this issue. (Kriek Bekker, interview, 17 September 2003)

Continued research and collaboration is of high importance due to the critical importance of feed to the commercial viability of aquaculture.

We have just brokered a technology visit and discussions with a Nordic country, on this field, on this level, whereby their knowledge and skills on feed and better feed formulation and better feed manufacturing, and better feed consumption by fish, is going to be part of a research collaboration between their research institutes on that side and our own environment including the Division of Aquaculture of Stellenbosch University. (Kriek Bekker, Interview, 17 September 2003)

Aquastel and development: Agri-villages

Aquastel's involvement with the regional (Western Cape) developmental, small-scale farming project, is considered very important⁹:

It can work and we must make it work, and also to test certain parameters, one of them being our own competency in making this programme work. (Kriek Bekker, interview 2003)

Aquastel's involvement in the area of food security and job creation presently also focuses on another area. Kriek Bekker was involved in various meetings with stakeholders during 2003 discussing the potential of aquaculture in alleviating poverty and creating jobs in rural areas. A NEPAD initiative called "Pushing back the frontiers of poverty" forms the backdrop of the discussions and is evaluating various promising projects, such as the agri-villages concept.

It will be crossing the borders of the whole Southern African Development Community (SADC) region. And what it involves is the creation of agricultural villages as part of a whole national and sub-region programme of bioregional planning for sustainable placing of people. Bi-regional planning actually just means the establishment of working environments that are in harmony with nature and with the economic drivers backing that up.

⁸ Aquaculture research, such as is undertaken within the Division of Aquaculture, focuses on a wide spectrum of aquaculture-related topics, such as quality of feed, optimal cage construction, and so on. This had the effect that Aqanutro was established. Collaboration with Alnet led to the redesign of their fish netting and a more suitable netting product for the aquaculture industry.

⁹ See Section 5.3

Now the agri-village concept is similar to what we have seen in Israel for many years, the Kibbutz-system, whereby a specific area, that lacks commercial drives and incentives, is identified to support a community in that specific region.

If job opportunities and good living conditions could be created, sustainable communities can be established. We certainly understand that agriculture; specifically aquaculture and a form of agronomy can become one of the supportive departure points being base-line fundamentals of such an agricultural village. And the concept and the idea is now that, in partnership with national, provincial and regional government right down to municipal level, we are going to implement nine regional agricultural villages, one in each province. And this agricultural village will include houses, the bare necessity infrastructures supporting it in terms of clinics, schools, a police station, the necessary shops; we are looking at round about a hundred households in an approximate area. (Kriek Bekker, interview, 17 September 2003)

The availability of land and water is critical to the establishment of these villages. Based on a careful selection of viable areas to establish these, nine pilot projects will be tested.

Aquaculture supported by other agricultural activities, will be central to these villages.

[] implement aquaculture whereby the fish farms, and producing food for economic sustainability, that fish will be sold to the community and the surrounding environments, will be supported by strong commercial agriculture events in that proximate area. But, this form of aquaculture farming is not only for food security for them, but as I said, it has to be self-sustainable. But then also, you know, the typical holistic hydroponics concept of the water flowing from the fish farms through tunnels in hydroponics where you produce lettuce, tomatoes and cucumbers, up to the extent where we know that Stellenbosch University through the Department of Agronomy, and making use of other tertiary institutions in the rest of the country. (Kriek Bekker, interview, 17 September 2003)

It is envisaged that researchers at universities closest to the targeted communities will be involved in the necessary research and development to establish such a project. The agri-village concept includes various aspects of capacity building and empowerment particularly enabling women to take responsibility for their lives and their families.

Components of it will be looking after the women, as well as empowering them in certain areas specifically around crafting, also the eco-tourist concept whereby certain of those water bodies would be made available to sports angling and eco-tourism and certainly use the manufacturing or the actual composition component of crafting as a tourist attraction. (Kriek Bekker, interview, 17 September 2003)

The potential of aquaculture as part of such an agri-village concept has aroused the interest of politicians, and Aquastel has made some presentations to cabinet.

So this thing is now getting attention of much bigger role players than merely a Division of Aquaculture or a Division of Agronomy. They will only be facilitating two or three aspects of the critical financial component of this agri-village. We are now looking at, maybe putting up the type

of benchmark "green village concept" that can also address the urban sprawl, the informal sprawl housing problem that is facing South Africa where a cluster of informal houses is just stuck together without making any sense. Within the context of a bioregional plan [] We are also involved with a substantial developing institution. It is an architectural urban developer, local one who has already facilitating a programme for the Western Cape Government, we are looking at certain bio-regional areas where people will be empowered, will have land ownership, will have commercial substance, will be supported and trained by us and skilled to farm and really look after themselves. Now, the idea is, as I said, to do this on a national basis, and certainly NEPAD is backing most of it, and certain of the other countries within SADEC wants it to be a collective one. (Kriek Bekker, interview, 17 September 2003)

5.3 Utilisation for development

When the Tilapia project was started, some concern was raised that it might mainly benefit the so-called "white agricultural fraternity" (Danie Brink, interview 2003) or the commercial fisheries sector. A need for a very specific initiative to benefit the small farmers and improve food security was identified. Early contact (1993/1994) between the Division and the Rural Foundation, a non-governmental organisation focussing on promising agriculture-related projects for development in rural communities in the Western Cape, contributed to the expansion in the Division. The Rural Foundation at the time ran a programme called "Rural Enterprises". Different fields in agriculture were identified as viable areas that could be utilised for development, such as essential oils (for example, derived from Aloes and peanuts), chickens and rabbits, as well as fish.

After its first introduction to the development through agriculture work that had been done by the Rural Foundation, the Division started early in 1995 to explore ways in which the Tilapia project could be extended towards the goals of rural development. Mr Brink mentioned the possibility of using aquaculture for development to Mr Khalid Salie (a postgraduate student at the time) and asked if he would be interested in getting involved in this.

In the early nineties, I was approached by Danie, specifically to look at the socio-economic development of aquaculture, because, at the time, they were looking at the potential of rolling this programme out into development. And they were looking for somebody and that is really where I became involved in aquaculture. (Khalid Salie, interview, 20 October 2003)

The position of development officer linked to the Division was established in April 1995. It was a shared contractual post between the Division and the Department of Agricultural Economics, more specifically the Community, Public Private Partnership programme (CPPP), which is a sub-division of the Department of Trade and Industry. The programme leader of the CPPP, who previously headed the Rural Foundation project, took up a position at Agricultural Economics when the CPPP started to focus on certain developmental projects within the agricultural sector.

Mr Salie is linked to these as the development officer/practitioner for aquaculture. Part of his responsibility is to raise and manage project related funding:

That means we will submit proposals for different research projects for different developmental projects, and from all the activities [flowing from this] and everybody that is involved within the programme, must be remunerated from it. (Khalid Salie, interview 2003)

The process that has resulted in the appointment of the development officer could be seen as the official birth of the Small-Scale Fish Farming Development Programme (SFDP) linked to the Division of Aquaculture. Salie gained technical experience by working for a year at Jonkershoek, the aquaculture station of the Division.

Main aims of development through aquaculture

The development question that had to be addressed was how aquaculture could be used to create additional income for farm workers, and further add to food security goals by making a good source of protein readily available to farm workers.

Primarily, we targeted farming communities and these guys do have jobs on the farms. So, it should be something they could do in their extra time, before they go to work, during lunch times, after work, over weekends, do this fish farming and get benefits from it, additional income. That was one of our main aims. The other aim was to see if we can provide an alternative source of protein. Not a cheap protein, because we know, when you look at fish farming and you look at intensive fish farming, there is no way that you are going to be able to produce "cheap", so to speak, protein. So it would be an informal protein or an alternative source of protein provided to farming communities on a regular basis. [] we know, according to our figures, the Department of Water Affairs told us that there are so many, 2000 and more dams available in the Western Cape that could be used for fish farming. And those were the dams that were registered. So, in order to be registered, it must have a dam wall of five meters, it must be something; I think 100,000 cub meters of water in it. [] We knew these dams were all privately owned on farms. So we had these farm workers communities on these farms. We know that Trout farming is working at the moment, based on the results that we had from the trials that we did at Elsenburg and Kromme Rhee. So, all these things were there, the technical side looked good, the socio-economic side looked also good. But, they needed somebody to put it all together and move the process forward, and that is where I came in. (Khalid Salie, interview, 20 October 2003)

The DFID funding of the Tilapia project added the stimulus to the research to develop and transfer technology that would benefit development and food security goals. The DFID funding made it possible to get the required capacity to deliver the technology, for instance into rural KwaZulu-Natal, to small-scale farmers.

Finding the right species and conditions for the development project

Through the link with the non-governmental organisation and the Western Cape Department of Agriculture at Elsenburg, extensive trials were run on fish-farming in cages

on dams at Elsenburg and Kromme Rhee. The approach from the start was a rotational two-species fish farming system. According to this approach, Trout would be the species of choice during the winter months (April/May to November) and Tilapia during the summer months (November/December to April). The two species would make it possible to have a continuous presence of fish in the dams around the year and therefore more cost effective.

We said we want to do a rotational fish farming system doing Trout during the winter months and then do Tilapia over the summer months, so everybody who is engaged in fish farming, will have a concern that runs twelve months of the year. [] If we can produce Trout, it's considered a high-value species for the luxury-end of the market. So the middle class or every guy does not buy Trout. So it's solely to be produced with the purpose of getting money for it to the people. And Tilapia will come in as an affordable protein, as an alternative source of protein, as a fresh sort of protein. [] Tilapia from the onset was very much part of our plans of developing aquaculture, bringing it in as an alternative summer species. (Khalid Salie, interview, 20 October 2003)

Only at one area in the Western Cape, namely at Ceres, the water temperature facilitates Trout farming through the summer months as well. The difference in summer and winter water temperatures at potential farming sites in the Western Cape where the development programme is in operation, introduces species-selection parameters that has implications for viability.

So where you have warm water, you cannot put Trout into it. When the water gets above 23 degrees, then you start getting trouble with farming Trout. So then it is when you want to do Tilapia, because it is ideal for Tilapia. So, when I get enquiries from people saying, we have water and would like to do fish farming, then I have to give them background to the programme, I still speak about rotational farming system. (Khalid Salie, interview, 20 October 2003)

For this reason, continued close collaboration between the Small Farmer Aquaculture Programme and the research team is vital. The development officer is often approached for advice on the cage/dam system, and must at all times be able to provide interested workers with up to date information.

So, it's crucial for me to have the information. I want to know at any stage no, but it is going to take another three years or it's going to take another two years to get fingerlings available. That is the information that I must have. So that I can brief the people who are enquiring about the system. (Khalid Salie, interview, 20 October 2003)

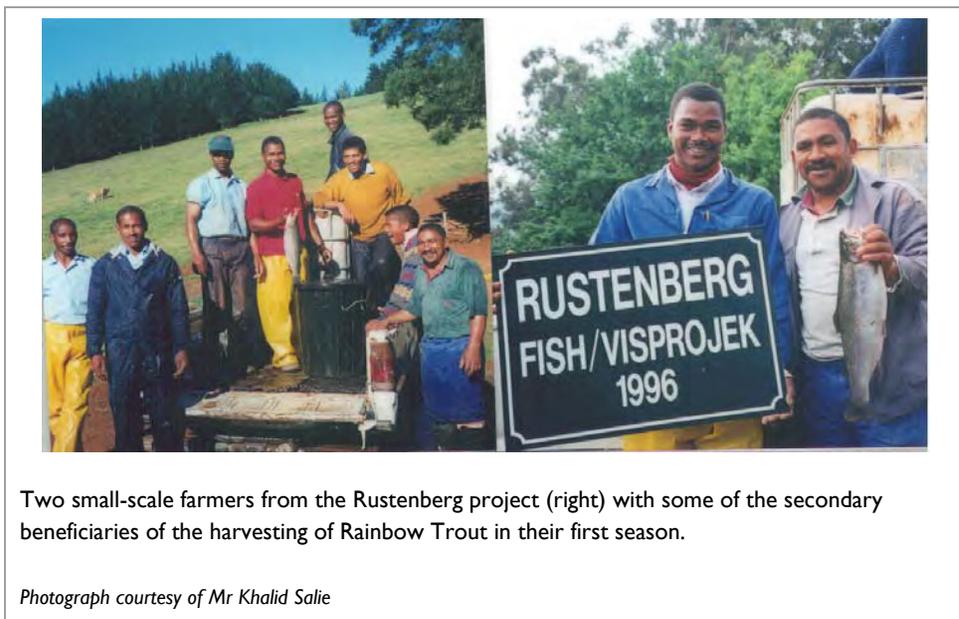
'Market research' and identifying sites and users

After the research had shown promise, the next step was to introduce it to communities. Potential sites, interested workers and farmers willing to cooperate and make their dams available had to be identified. The most feasible areas for launching these pilot projects had to be established. Market research was done during 1994 and 1995 in collaboration with the non-governmental organisation locating the target communities, as well as establishing

what the market response would be to aquaculture.

During 1995 [] I did a bit of work with the NGO, market research just to see what the perceptions of the people out there were about fresh water fish. [] We have done some preliminary tests with Tilapia where we have put some of the Tilapia in cages in dams. But they were mixed-sexed fingerlings, so we couldn't really gauge what the impact of Tilapia is. What we know is that there is demand out there. We have taken those Tilapia and distributed them amongst communities in Oudtshoorn, in Grabouw, Worcester and Stellenbosch, where we had these Tilapia made available to communities. We had the feedback and we had the reports available, so what were the outcomes of that research? How do people feel about fresh water fish in the Western Cape? Will people take to it? So, these results are available. And the results were predominantly positive. The people will buy it if we can produce a certain size of fish and it can become available and not too expensive and those kind of things. These are the things that came out of that report. (Khalid Salie, interview, 20 October 2003)

Presently, small-scale aquaculture is practised at five sites in the Western Cape – one each at Ceres, Worcester and Paarl, and two at Stellenbosch. Small-scale aquaculture ventures vary between community-managed farming and privately owned farming.



Two small-scale farmers from the Rustenberg project (right) with some of the secondary beneficiaries of the harvesting of Rainbow Trout in their first season.

Photograph courtesy of Mr Khalid Salie

Regarding community-based projects, farm workers' committees that are the legal entities on farms, are responsible for managing the project. With individual projects, the development officer was at times contacted with requests for advice.

[There were times when] we had some individuals coming forward saying, we want to do fish farming, where can I get information? We had two of these guys. One who wanted to retire as a teacher, the other one retired as

a carpenter, and they came forward and said, we want to do fish farming. I provided them with the information and we approached the municipal dam and they got a lease for it and they are probably the last four years in Worcester. So they are individuals. And then we had like for instance some technicians working for the municipality, but in his free time he can spend some time and invest in some on it for additional income. (Khalid Salie, interview, 20 October 2003)

Non-utilisation of research results in the development context

Despite all these initial steps, towards the end of 2003 (Mr Salie was interviewed at this time), the Tilapia had still not been made available to the small-scale farmers. As such, the rotational system (using Trout in winter and Tilapia in summer) could not be implemented, because the Tilapia fingerlings were not available to the small farmer community for introduction into their cage systems. Not having Tilapia fingerlings available during the summer months meant that the dams stood empty and could not be fully utilised. It also meant that the farmers' businesses ground to a halt. Not surprisingly, the small-scale fish farmers have been anxious to include Tilapia into the full year production cycle as was envisaged with the introduction of the programme.

The reason why the farmers have not yet received fingerlings is because Tilapia was earmarked for commercial application first by the Division. As a result, the research for development purposes specifically is not yet complete:

Since 1995 up to now, 2003, all the farmers have been involved. They start out with Trout and then, the idea was, for all of them, to produce Tilapia as a summer species. But, up to today, the research hasn't really delivered a candidate species of Tilapia for summer-production. [] There are still a few things that we have to investigate in terms of husbandry, in terms of growth rates within cage systems, because traditionally your Tilapia grow better in earthen ponds, so those are things that still needs to be investigated. (Khalid Salie, interview, 20 October 2003)

The rationale for establishing the commercial viability of aquaculture locally before using the technology for development was highlighted by Mr Salie:

We need to develop a market, because it is no use to go through all this technological research if you can't use it in the markets. [] You've got to develop the local market. I mean it's all good and well if you can export, but what about our local market? So there are two ways of approaching this. I say this on a continuous basis, where are you guys? Where is the research now? Because we need the research to implement it. We need to test it in order to make our farming systems more profitable. But there is also the argument now, we first have to develop the commercial side of it so that the market can be developed and once that is in place, then we can, sort of, create spin-offs, give it to the small-scale farmers. (Khalid Salie, interview, 20 October 2003)

The other side of the coin, however, is that the commercialisation focus might detract from the implementation of the development goals:

[Commercialisation] can be good, when you have the muscles, you have the bigger guys and the bigger industries coming in with a lot of money and time and expertise and really focus on developing this market. Because people need to know there is Tilapia available and it can be bought at supermarkets and different varieties of products. That it is available. So it is good if we get the bigger guys in to develop the commercial side of it. On the other side, I am a bit concerned that the commercialisation of Tilapia is going to run away from the small-scale farmers, and that the catch up is going to be difficult. So, my feeling is that there must be some sort of synergy between the commercial and development aspects, where the commercialisation gradually drags the small-scale farmers with it. That means trickle down the effect of small percentage of exposure so that they grow through the whole process. (Khalid Salie, interview, 20 October 2003)

The commercial players and the small-scale farmers are two separate and different constituencies. The possibility does exist, however, that small-scale farmers might be involved in some of the aspects of the commercialisation structure, depending on their capacity:

I would like to address the full participation of small-scale farmers and not just outgrow, otherwise, there is no real development, because you just use them to do someone else's work. So, what type of other capacity building would be included would be written into such a programme. Because, the one thing that I am also concerned about is that the whole thing is actually going to overshadow where you have the small-scale farmer in the middle, and the hatchery on the one side and the feed guys on the one side, and the financial guys on the one side, all in good faith, but I would really like these [small-scale farmers] in future to come out and say, but I can do the marketing or I can do the hatchery development, I can be involved in different aspects. And not only being involved in the outgrow of the fingerlings. (Khalid Salie, interview, 20 October 2003)

The prospect of developing a small-scale farmer into a commercially viable operation should be an open and real possibility.

I'm not sure all of them will grow into it. It doesn't mean that all of them must become big marketeers. But I would want them to have the potential and the opportunity to access different aspects of the development or the commercialisation of Tilapia. And that goes for other aspects as well, for the Trout as well [] We are looking at other ways. That is why I understand the routes very clearly. You have the out-growers and small-scale farmers but what are we creating for them to get out of that laager? (Khalid Salie, interview, 20 October 2003)

The establishment and development of aquaculture for small-scale farmers has been continuing for almost a decade. Although there were some failures within the programme, feedback from farmers that continued was very positive.

Because we had programmes that are community-driven. We have programmes that are entrepreneurial-driven. We have programmes that are driven by part-time workers. So the institutional structure is different for each project and the benefits are also different. And [] the one project is doubling in production. (Khalid Salie, interview, 20 October 2003)

The small-scale fish farming development programme has grown to such a level that it has outgrown the capacity of the University of Stellenbosch to manage this. This process has been taken to a stage where these farmers have formed their own co-operative that is known as “Hands-on”. Activities previously driven by the Division and the university have been transferred to the co-operative. A consortium of bodies, such as the small business unit, provides the skills relating to financial and business management and practical aquaculture training and extension is provided by Elsenburg.

The small-scale fish farmers indicated that they see themselves equipped and, therefore, are prepared to take full responsibility for servicing their marketing contracts and agreements. The various aspects of a business, such as finances, invoicing and auditing are managed by a small company called “I Farma” was established for this purpose. “I Farma” focus on financial and business administration in the agriculture context and become involved at the stage when the business grows from a small- to a medium- or large-scale business. Cash flow monitoring and working capital security are important aspects of their service. The supervisory function of the small aquaculture businesses on farms previously managed by the SFDP, are now being handed over to “I Farma”, while the Division still takes responsibility for the technical support. From the Division’s side, the link with the small farmers is done on a cost recovery basis. Training sessions, etc. are held to equip them with the necessary skills. An approach to training that will focus on the level of the farmer is very important. According to Mr Brink, the training should not be too technical but should still provide enough information to help them being successful:

With the small farmer, particularly in the rural communities, I sometimes find it difficult to find the right approach so that it will not come over in a paternalistic way. We sometimes just lack the time to work out the right approach. For example, if you take some 25-year-old black guys from KwaZulu-Natal, Grades ten to twelve, you must try to convince them this is the best measure that they should follow, it is a Tilapia fingerling, and during the year, hopefully you will get a chance to explain why they must do things as you suggested. So, there are still some shortcomings. (Danie Brink, interview, 10 September 2003)

The kind of interaction between the Division and the small-scale farmers is a very direct relationship.

Obviously with the small farmers, it is really much a one-on-one thing. We have had probably four training programmes. We also make sure that they now participate fully in the commercial structures, like the farmers’ associations and so on. And normally every year one

trainingship course where they will receive some more skills and move into a new phase. Further it is very much a one-on-one set-up. (Danie Brink, interview, 10 September 2003)

The focus on a commercial application of the Tilapia technology also had, from its inception, the goal of contributing towards establishing small-scale aquaculture and thereby contributing towards particular food security ideals.

That is why we are working with a model stating that if you can link food security with a viable commercial entity, then the commercial entity drives the initiative and facilitates a lot of services and improves the efficiency of a lot of services, and even create some product awareness. (Danie Brink, interview, 10 September 2003)

The perception is that the growing commercial value would impact on the re-evaluation of the species amongst local communities and changes the perspective of the species from a low value to a commercially valuable commodity. This commercially driven model of development unfortunately has to face the reality of a time lapse between the commercial feasibility and the developmental implementation. Food security is sustained, according to this model, by the linkage with a viable commercial entity that drives the initiative and facilitates many key services, as well as product development and awareness.

The value and impact of the YY-super male technology for agriculture and development is also being discussed with other countries in Southern Africa such as Namibia, Botswana, Angola, Tanzania and Swaziland. The University of Stellenbosch Division of aquaculture is the only centre engaged in research and development of this species in Africa.

When we realised what was initially an obstacle, has become a responsibility and now it is an opportunity. I think every one here realise that what was an obstacle in the past, we now have the skills and capacity to make it an opportunity. (Danie Brink, interview, 10 September 2003)

Collaboration for development

The SFDP has entered into collaborative relationships with various organisations in order to reach the development goal. Collaboration was on different levels such as with non-governmental organisations and capacity building organisations.

We used to have links with the Rural Foundation that is now CIRDA, the Centre for Integrated Rural Development, that's an NGO. Another NGO is the SBLC, the Stellenbosch Business Learning Centre, we work with them. And then we had numerous inquiries from other NGOs who also want to look at this and start with this. But at the present moment, the important one is Stellenbosch University, the Department of Agriculture at Elsenburg and Stellenbosch Business Learning Centre. The role of CIRDA has diminished at the moment. Then also, the CPPPP programme is important. (Khalid Salie, interview, 20 October 2003)

The Stellenbosch Business Learning Centre (SBLC) focuses mainly on business training and mentorship programmes to develop rural communities through agriculture, including aquaculture. They also assisted with the market research on Tilapia. The collaboration between SFDP and SBLC has since decreased.

The Western Cape Department of Agriculture at Elsenburg has mainly helped with basic courses and with research, as well as providing extension services to small farmers involved in aquaculture.

CPPP is still one of the most important co-workers of the SFDP because of their expertise in providing business training, feasibility studies, market research, seed funding for development, etc. They fulfil a strategic role in the small farmer programme.

The Ceres Development Consultants (CDC) is another non-governmental organisation with whom the SFDP has collaborated. They, in turn, link with the Witzenberg local government structure.

Assisting the prospective small farmers financially remains quite a challenge. The role of the SFDP is to facilitate the process of securing funding. The SFDP office puts the new farmer into contact with the CPPP who, in turn, assists them by drawing up a business plan that can be submitted to different organisations, either private or governmental, for financing.

Institutions financing agricultural ventures are for instance the Department of Economic Affairs, the Development Bank and Landbank.

Where we are dealing with farm workers, we try to encourage the farm owners to provide loans to the farm workers. He knows his people, he knows where the money is going, and we had success in this for instance one in Rustenberg, there the workers got finance from the farm owner. The Ceres project was government financed. (Khalid Salie, interview, 20 October 2003)

Providing consultancy and sound advice to people interested in aquaculture remains the most important role of the SFDP.

When somebody would phone you and say, I want to start fish farming, where do I go? Then we can say right, first of all you need to draw up a feasibility study, a business plan, these are the people that can help, and then from there, these are one, two, three, four, five possible areas where you can access finance. Of course there are facilities available in government if people can qualify for grants, and then can also be transferred into aquaculture. The Department of Water Affairs has specific grants, but most of the grants will actually be done by the farmers. (Khalid Salie, interview, 20 October 2003)

Collaboration with a non-governmental organisation operating in northern KwaZulu-Natal regarding food security and sustainability is also assisting the small farmer project there. When meetings between the Division and commercial companies are held in

KwaZulu-Natal, development progress is also discussed with members of this non-governmental organisation. The commercial players are carrying the overhead costs of the research regarding small-scale farmers and food security.

The relationship between the development office, the research team and the commercial company (Aquastel) was always open and direct. The development officer believes that the particular requirements of small farming communities were taken into account by the research team. The development officer communicated specific needs as experienced by the small-scale farmers to the research team.

Research outputs were generated in the form of reports, publications and workshops.

*I've been involved with all of those, most of them. I'm aware of it, we are busy writing a national policy framework on aquaculture. Publications, we had done a lot of publications where we have done numerous research projects like collaborative research projects with other universities, overseas institutions, we've written hundreds of articles for **Farmer's Weekly**, etc. (Khalid Salie, interview, 20 October 2003)*

Regular meetings were held between the research, development and commercial role players during the course of the project.

We've met on a regular basis. Monthly, more than monthly, probably three times a month, [] during all the stages of the project. (Khalid Salie, interview, 20 October 2003)

Report-back sessions, where the research findings were shared and discussed, also included the development officer:

We had a monthly meeting where all the research was put on the table and everybody's work on everything would be put into a progress report and we would all move forward together. That is something we are looking at to introduce again. Because at the moment, given the range of activities that everybody is involved in, it has sort of faded. But we try to revitalise these meetings. So that everybody knows at any stage where all the research projects are and what would be the approach after that. But know, it's more something that the individual has to update and try to communicate the progress of the particular research project. So if you know something, you will pick up the phone and phone Danie, or you'll phone Kriek or you'll phone these guys and ask where are we now [] So, we probably need to look at and trying to introduce that type of more formal structure again. Where we can report back and progress reports can be delivered and new projects can be laid on to the table and we all can be part of the vision. At the beginning of each year we have a Divisional meeting where we introduce new staff and introduce new projects, but the follow-up through the year is something that must receive more attention. (Khalid Salie, interview, 20 October 2003)

6 Concluding comments

During the course of twelve years, the Genetic Improvement and Utilisation of Tilapia project had grown from being a small and almost insignificant project with limited influence, to one that is supported by government (THRIP) and industry, with a dense network of collaborating partners. The research capacity that has developed at the Department of Genetics in the area of the genetic improvement of a fish species holds promise for the whole aquaculture industry in South Africa, as well as addressing the strategically important aspect of contributing to food production in South and Southern Africa.

The project has had an impact on multiple levels. The production of knowledge through this project was on the level of applied research. Known research methodologies developed and applied elsewhere were utilised in the selection and improvement of a local fish species. Through this process, a South African university, more specifically the researchers and senior students within the Department of Genetics at the University of Stellenbosch, acquired the necessary know-how for genetically improving a fish species to such an extent as to have sustainable commercial value. The necessity for knowledge creation was stimulated by the need for a viable aquaculture resource for South and Southern Africa. Therefore, a process of 'knowledge pull' from the fishing industry had an impact on the research requirement and dynamic.

The express goal of commercialisation introduced a dynamic to a research process that was new to the researchers and, to a certain extent, to the University. The project developed unique partnerships with industry. Due to a dependency on funding from the aquaculture industry, a close collaboration between academia and commerce that spanned almost a decade had a particular impact on the research.

The intellectual property issue became a central and important element of the Division's concern as soon as the Tilapia technology was ready for commercialisation. An intricate network of intellectual property concerns had to be dealt with: between the original research partners (Swansea and Stellenbosch), between the knowledge producing researchers and their home institution, the University of Stellenbosch, between the research team and the funding agencies as well as new interested parties wanting to join the process. Various memoranda of understanding had to be signed between the academic partners, Stellenbosch and Whales / Swansea, and the commercialising bodies Unistel and Aquastel. The commercialisation process was to a large measure managed by the Office for Intellectual Property at the University of Stellenbosch and regulated by the University's policy for intellectual property.

Regarding the impact of the research on the developmental and food security levels, promising developments did take place, but the fact that the Tilapia technology was not made available to small farmers at the same time that it became available to industry, frustrated the process.

In the area of job creation, the aquaculture small farmer project contributed to the development of business skills and the creation of new opportunities to small-scale farmers, utilising existing resources on farms in the Western Cape. New aquaculture ventures did create more job opportunities.

In principle aquaculture does not create a lot of jobs, but it does have spin-offs into other areas. There is a very interesting international formula: it has been said in the aquaculture world, one permanent job in fish farming or aquaculture creates fifteen indirect jobs and creates 45 people that have food security from that one solid job. So, it concerns the spin-off aspects of this farming, it really creates a lot of jobs. (Kriek Bekker, interview, 17 September 2003)

6.1 Key observations and lessons learnt

- ◀ Different forms of collaboration ensured the success of reaching the goals of the project.
 - ◆ Academic collaboration with research units in Europe proved to be of vital significance to build local research capacity and make informed research decisions. These research links were dynamic and shifted according to requirements, but remained of great importance throughout the project.
 - ◆ Collaboration with the local fishing industry was important because it made necessary funds available for research while also help to define the strategic need for the research.
 - ◆ Collaboration with the Office for Intellectual property at the University of Stellenbosch was central in establishing the framework for commercialisation and the future relationship with industry.
 - ◆ Collaboration with non-governmental organisations and the Rural Foundation, and the establishment of a post for a development officer, proved to be important in reaching the development goals of the Division. New partnerships were formed and capacity built with small farmers.

- ◀ Utilisation took place on different levels according to the constituency taking up the research results:
 - ◆ On the academic level, the research outputs were shared with colleagues and students during seminars and lectures. The results were also reported in various publications (academic and general) as well as in conference proceedings.
 - ◆ Commercial utilisation being the focus of the research is mediated through Aquastel, the commercialising company. Because the technology is still new and was only introduced fairly recently, the process of commercialising it is still in an early phase, and is expanded through the establishment of new aquaculture businesses.
 - ◆ Utilisation on the level of agricultural development did take place in the building of capacity and the advancement of knowledge of small-scale farmers. Although the technology is still not available to small-scale fish farmers, they did acquire skills on the various aspects of running an agriculture business.

- ◁ The knowledge transfer agents varied according to the focus constituencies:
- ◆ The Department of Genetics is the primary knowledge transfer agent
 - ◆ Aquastel served as knowledge transfer agent to the commercial aquaculture industry, while
 - ◆ The office of the development officer served as transfer agent to small-scale fish farmers.
-

Data sources

Face-to-face interviews

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- Mr Kriek Bekker (Manager, Aquastel), 17 September 2003
- Mr Jacques Stofberg (Office for Intellectual Property, University of Stellenbosch), 6 October 2003
- Mr Khalid Salie (Development officer, Small-Scale Fish Farming Development programme, University of Stellenbosch), 20 October 2003

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- Follow-up interview with Mr Kriek Bekker, 24 September 2004

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CASE STUDY 3

SEQUENCE TAG ALIGNMENT AND CONSENSUS KNOWLEDGEBASE

Bioinformatics for capacity building, discovery and commercial success

A database project initiated by Prof Win Hide of the South African National Bioinformatics Institute, University of the Western Cape

by Nelius Boshoff



DNA double helix, photograph courtesy of the website of the National Human Genome Research Institute in the United States [<http://www.genome.gov/11006909>]

CONTENTS

Abbreviations	151
1 Introduction	152
2 The broader organisational context	153
2.1 The South African National Bioinformatics Institute (SANBI)	153
2.2 MRC/UWC Bioinformatics Capacity Development Unit	154
2.3 National Bioinformatics Network	155
2.4 S* Consortium	156
3 Sequence Tag Alignment and Consensus Knowledgebase (STACK)	156
4 Commercialisation of STACK through Electric Genetics	157
4.1 Electric Genetics and the Innovation Fund	158
Obtaining Innovation Fund support	158
Facilitating technology transfer through the Innovation Fund support	159
The return on the investment	160
4.2 Electric Genetics and its relationship to UWC and SANBI	160
Electric Genetics and UWC	160
Electric Genetics and SANBI	162
4.3 Transfer of STACK from Electric Genetics to commercial and academic users	164
5 STACK and bioinformatics training and capacity building	166
6 STACK and scientific discovery	167
7 Concluding remarks	168
Data sources	171
Face-to-face interviews	171
Publications and documents	171
Websites visited	172

Abbreviations

CAPRISA	Collaborative Aids Programme of Research in South Africa
DST	Department of Science and Technology
MRC	Medical Research Council
NBN	National Bioinformatics Network
SANBI	South African National Bioinformatics Institute
STACK	Sequence Tag Alignment and Consensus Knowledgebase
UWC	University of the Western Cape

1 Introduction

Bioinformatics is the science of managing and analysing biological information or, differently put, the application of computational techniques and information technology to biology. The products of bioinformatics are databanks and computer software tools (Pongor & Landsman 1999). These products provide the necessary technological platform for advances in modern biotechnology, especially in the study of genes and their actions (i.e. genomics). The enabling role of bioinformatics in biotechnological research is also stressed in the national Biotechnology Strategy for South Africa, which was released in 2001. According to this strategy:

Bioinformatics has become an indispensable part of the infrastructure required for biotechnology research. Furthermore, human resource capacity in bioinformatics has become increasingly important across the spectrum in biotechnology, including biopharmaceuticals and plant biotechnology. The enhancement of our competency in bioinformatics has the potential to place South Africa at the forefront of this field. (DACST 2001:41)

Most bioinformatics resources are distributed in the public domain, meaning that they are freely available over the Internet. However, the use of these resources requires specialised training and skills. As a result, developing countries often lack in capacity for advanced bioinformatics.

At present, advanced bioinformatics is concentrated in a few research centers and private companies around the world that have the capacity to employ personnel with highly specialized training. In spite of the fact that bioinformatics methods are freely accessible, there is clearly a gap between the developing and the industrial world, which must be consciously narrowed. (Pongor & Landsman 1999:5)

The building of capacity in bioinformatics in South Africa was a main motivating factor behind the establishment of the South African National Bioinformatics Institute (SANBI) at the University of the Western Cape (UWC). SANBI was formed in 1996 around an extensive database project, called Sequence Tag Alignment and Consensus Knowledgebase (STACK). With the aid of computer technology, SANBI has organised and structured bits and pieces of genes contained in databanks around the world, in order to learn more about disease and its location within the human genome.¹ Thus, a core aim of the STACK undertaking was, and still is, to inform new drug development through the so-called 'discovery' of genes. The technological products of the STACK project are also used as a platform in the building of national and regional bioinformatics capacity. The products have been successfully commercialised (to non-academic users) by Electric Genetics, a spin-off company.

This report is structured according to the three main applications of the STACK technology: commercialisation, capacity building and scientific discovery. The knowledge production aspects of the broader STACK project are integrated within the discussion.

¹ The human genome represents all the genetic material in a human cell and comprises approximately 30 000 genes. Each gene determines certain human characteristics, ranging from hair colour to the propensity to develop certain diseases (Shapshak 1999).

However, before looking at the three applications, an organisational context will be provided.

2 The broader organisational context

2.1 The South African National Bioinformatics Institute (SANBI)

SANBI was established in April 1996 at the University of the Western Cape (UWC), with Prof Win Hide² as director. The UWC is a historically disadvantaged university situated in Bellville, near Cape Town. Prof Hide is a native South African who studied and worked overseas for most of his life. In the mid 1990s, with the change to democracy in South Africa, he returned to the country with a strong desire to promote bioinformatics capacity. The start of local bioinformatics is linked to the establishment of SANBI, which, in turn, is closely tied to the development of the STACK database. Prof Hide explains:

The [STACK] project was initiated at the request of a scientist in the United States, where I was living, who knew that I was looking for projects to fund bioinformatics research upon my return to South Africa, because I wanted to come home and start doing bioinformatics here and there was no bioinformatics [] This guy had connections with the United States Department of Energy and he provided a conduit for me to receive fifty thousand dollars to generate a database [STACKdb] that would align [] expressed gene products to each other and provide that through a research institute that he had in the States. (Win Hide, interview)

Prof Hide received his initial funding for SANBI from the United States National Center for Genome Research. It is a research institute situated in New Mexico and is a not-for-profit bioinformatics organisation created from funds from the United States Department of Energy to support the Human Genome project³ (SANBI 1996). Thus, Prof Hide came to South Africa with money from the United States to start research in the field of genomics. Originally, SANBI began very small with only Prof Hide and a database expert:

I came back here and fifty thousand dollars in those days was lots of money and it allowed me to set up a very small institute and to hire a single individual who was an expert to perform the coding and the ... software implementation to generate the database. (Win Hide, interview)

² Prof Hide's background is in evolutionary biology and genomics and his experience is in the development of high performance tools for the analysis of the human genome. He was a Keck fellow in the United States at Baylor College of Medicine and also a fellow at the Smithsonian National Museum of Natural History in Washington DC. He has been a doctoral graduate of Temple University in Philadelphia and, prior to his return to South Africa, the director of Genomics at MasPar Computer Corporation in Silicon Valley (<http://www.e genetics.com/>).

³ The United States Human Genome Project formally began in 1990, as a 13-year effort coordinated by the United States Department of Energy and the National Institutes of Health. The project originally was planned to last 15 years, but rapid technological advances have accelerated the expected completion date to 2003. Project goals were to (1) identify all the approximate 30 000 genes in human DNA, (2) determine the sequences of the 3 billion chemical base pairs that make up human DNA, (3) store this information in databases, (4) improve tools for data analysis, (5) transfer related technologies to the private sector, and (6) address the ethical, legal, and social issues that may arise from the project. (http://www.ornl.gov/sci/techresources/Human_Genome/project/about.shtml)

SANBI started as a little office with an SGI Indigo 2, donated by Julie Nash at SGI, and a borrowed Macintosh. The office was shared by Win Hide ... and Rob Miller, an American who had trained in Janet Thompson's Lab at UCL [University College London] in the UK. (http://www.hgmp.mrc.ac.uk/embnet.news/vol5_1/nodefocus.html)

Thus, SANBI originally began with only Prof Hide and Dr Rob Miller, a postdoctoral fellow from overseas. Today SANBI has a staff complement of 11, including various technical and administrative employees. The mission of the institute has been clearly defined, with four objectives (<http://www.sanbi.ac.za/>):

- ◀ To create modern awareness and interaction with genome biology and analyses
- ◀ To develop analysis systems relevant to the South African community
- ◀ To provide human resource development in the area of bioinformatics, and
- ◀ To conduct topical research in bioinformatics and computational biology.

According to the SANBI website (<http://www.sanbi.ac.za/mrc/research.html>), students work with SANBI in one of two ways: either as postgraduate UWC students who are learning the discipline and also contributing to genome research, or as students from other institutions who approach SANBI with problems that are relevant to genomics in a broad sense. SANBI then trains them so that they would be able to support future problems at their own institutions.

Moreover, SANBI is involved in various projects in the field of genome research. All of these are collaborative projects, with local and international collaborators, such as the European Bioinformatics Institute, the EU GIFT consortium⁴ and the Wellcome Trust. SANBI is also a member of the Collaborative Aids Programme of Research in South Africa (CAPRISA), which is funded by the United States National Institutes of Health. As part of CAPRISA, SANBI is involved in research in the evolution of HIV sequences (<http://www.sanbi.ac.za/research.html>).

The following section maps the three organisational structures within which SANBI operates, and focuses on SANBI's very first project, namely the STACK project.

2.2 MRC/UWC Bioinformatics Capacity Development Unit

Prof Malegapuru Makgoba, who was the Head of the South African Medical Research Council (MRC) from the late 1990s to the early part of the century, felt positive about the contribution of bioinformatics to the development of biotechnology in the country. His suggestion to Prof Hide, who wanted to apply for a dedicated MRC/UWC research unit, was to rather apply for a capacity development unit (a category of unit which, officially, does not exist at the MRC because the latter primarily funds research). This was a clear

⁴ GIFT (Genome Integrated Force in Type 2 Diabetes) is the collaborative research grouping assembled by the major European centres involved in the study of the genetic basis of type 2 diabetes in Europe. GIFT have received funding from the European Commission to enable the component groups to pool their expertise and research resources to advance efforts to understand the genetic basis of type 2 diabetes (<http://www.gift.med.ic.ac.uk/>).

deviation from the MRC's criteria for the establishment of units at higher education institutions.

The proposal was approved and, in 2001, the multi-million Rand unit opened at UWC. According to the MRC's website (<http://www.mrc.ac.za/>), the unit is dedicated to:

- ◀ The development of an online specialised resource for genomics and genome information
- ◀ Capacity development in genomics and bioinformatics in South Africa, and
- ◀ The development and implementation of genome annotation methods.

As part of its activities, the unit offers a MRC research training internship programme for black trainees (see Section 5). From the interview with Prof Hide, it seems that he was given much freedom in using the MRC funds for capacity building:

I've acted like a mini funding agency myself, I've made the personal decisions, I will fund that individual to do that project or I will fund this trainer to fly around the country and train, etcetera. The result of that has been the building of general knowledge of bioinformatics in the country. So I've contributed quite significantly to that. Subsequently I used the support from the Medical Research Council Bioinformatics Capacity Development Unit to support the development of a national infrastructure for capacity in bioinformatics. (Win Hide, interview)

The funding from the MRC generated, to some extent, a nationwide bioinformatics infrastructure, that was recently formalised into a National Bioinformatics Network.

2.3 National Bioinformatics Network

The National Bioinformatics Network (NBN) is an independent organisation that began in January 2003, and which was initiated by a multi-million grant of the South African government (through the Department of Science and Technology (DST)). The grant extends over a three-year period and amounts to R42 million in total (NBN 2003). The objectives of the NBN are to:

- ◀ Stimulate and support the adequate growth and development of bioinformatics as a scientific and applied discipline in South Africa at an internationally competitive level;
- ◀ Build local capacity in this field, especially amongst the previously-disadvantaged groups of society, by providing local and networked opportunities for staff and students from appropriate bioinformatics fields at independently assessed local tertiary and research institutions;
- ◀ Create an environment that supports business opportunities for the application of bioinformatics within biotechnology companies, universities and research institutions that will contribute to the economy; and
- ◀ Support and create research programmes that address appropriate local and regional problems experienced in the environmental, health, agricultural and industrial biotechnology fields (<http://www.nbn.ac.za/>).

The NBN is made up of a network of nodes, situated at six universities in South Africa. There is a central administrative and technical core, at UWC, operating in close association with, but completely independent of SANBI. Then there are five other associated and interconnected, but independent nodes (at the Universities of Cape Town, Pretoria⁵, Rhodes, Stellenbosch and Witwatersrand). The nodes are responsible for research, teaching and training programmes and service provision.

SANBI, for instance, has two research programmes that operate within the NBN framework. The one is on gene expression biology, with three subprojects: Building ontologies for gene expression; polymorphic splicing and gene structure evolution; and normal gene expression variation and aberrant gene expression in cancer. The second programme is on pathogen bioinformatics, with a focus on African disease. It also has three subprojects: tuberculosis, HIV, and malaria bioinformatics (<http://www.sanbi.ac.za/>).

The NBN supports honours, masters and doctoral students at any of the six nodes.

2.4 S* Consortium

SANBI is also part of the S* (pronounced ‘S Star’) consortium. It is a virtual alliance of eight universities⁶, which provides a “global, unified bioinformatics learning environment” (GLOBULE) made up of modular courses in the disciplines of genomics, bioinformatics, and medical informatics. The mission is to provide everyone with an introductory course in bioinformatics. The course is presented online, via a collection of lectures on the Internet (<http://www.s-star.org/>). The lectures are free and constantly available. There are also occasional courses in which students enrol, learn, are assessed and receive participation certificates.

3 Sequence Tag Alignment and Consensus Knowledgebase (STACK)

The development of the STACK database did not happen in Cape Town alone but also at other sites in the world because of Dr Miller’s work commitments. According to an anecdote on a British website:

Rob [Miller] was horrified to learn that he was funded by the US government to work with ESTs. As we all know, these are the most violently despicable of all types of sequence as they really are of low quality. Rob moved to Durban in disgust and, via a remote link, managed to work in Japan, the USA and Cape Town, to produce the database now known as STACK. (http://www.hgmp.mrc.ac.uk/embnet.news/vol5_1/nodedefocus.html)

The STACK database, or STACKdb as it is commercially known, is not the only technology-related project output. In fact, the most important output of the project is the set of tools that was used to create the database, called stackPACK. Both STACKdb and stackPACK have been successfully commercialised by Electric Genetics (see Section 4).

⁵ The University of Pretoria node also involves the Council for Scientific and Industrial Research and the Onderstepoort Institute of the Agricultural Research Council.

⁶ Apart from SANBI at UWC, the other members are Macquarie University (Australia), University of Sydney (Australia), Karolinska Institutet (Sweden), University of Uppsala (Sweden), National University of Singapore (Singapore), Stanford University (USA) and University of California, San Diego (USA).

However, what is the database all about, and what are ESTs? In non-technical language, the STACK database is a comprehensive representation of the sequence of each of the expressed genes in the human genome. An even simpler explanation is the following:

Genes found out there in databases are fragments of fragments [] It's like walking into a library and finding that all the pages of all the books have been torn out and put in a pile. Although you can pick any page and read it, that page doesn't make sense on its own. What we've done is put all the pages back into the right books. (EG 2000)

STACKdb thus contains special configurations of fragments of genes in the form of so-called transcripts or “expressed sequence tags” (ESTs) – the latter are short DNA sequences that are identified to be expressed as proteins:

Stack database gives users access to over a million so-called “expressed sequence tags,” or ESTs, which are bits of genes that give a significant amount of information about a gene's function. (Wired News 2000)

The utility of ESTs within the context of scientific discovery is that it can help to narrow down and identify specific genes that are responsible for human disease:

ESTs contain enough information to allow investigators to search databases for similar genes – the standard method used by researchers to get a better idea of what type of gene they've found. By studying and comparing these pieces of genetic sequence, research can eventually learn which tissues in the body the gene controls. (Wired News 2000)

Although the majority of sequence data are in the public domain, there is a cost involved in producing ESTs. STACKdb was therefore commercialised, as well as stackPACK, the clustering tool that was used to create the database. stackPACK allows researchers and companies to cluster their own proprietary EST data. The commercialisation occurred via Electric Genetics, a spin-off from SANBI.

4 Commercialisation of STACK through Electric Genetics

Prof Hide and Ms Tania Broveak-Hide⁷ co-founded Electric Genetics Pty Ltd in 1997 (Ms Broveak-Hide is Prof Hide's spouse). They met in Silicon Valley in the United States, where both were working for computer companies. Prof Hide persuaded her to come to South Africa in 1996 to assist with the commercialisation aspects of his STACK project, at which stage they were still unmarried. Ms Broveak-Hide explains the motive behind the establishment of Electric Genetics as follows:

SANBI has created the STACK database and Win Hide and myself were known overseas in bioinformatics and some of our old contacts in the pharmaceutical companies were asking if they could purchase

⁷ Prior to founding Electric Genetics, Ms Broveak-Hide spent two years providing strategic marketing and business development services, through her own consultancy, to virtually every major bioinformatics company including GCG, Pangea Systems, Molecular Applications Group and DNASTar, to name a few. Before launching her consulting business, she was employed by Oxford Molecular Group as Bioinformatics Marketing Manager and, prior to that, at IntelliGenetics Inc in various marketing and sales roles, culminating with a position as Software Marketing Manager and participating as a director of the company. She received her BSc in Biomedical Engineering from Northwestern University in Evanston IL (Wired News 2000; <http://www.e genetics.com/>).

STACK. Win, as an academic, didn't want to get involved with commercialisation – the university had no commercialisation office – and so we started Electric Genetics as some kind of sales agent for the university. (Tania Broveak-Hide, interview)

Whereas Electric Genetics originally began as a sole proprietorship⁸ (with Prof Hide as the owner), it was registered in 1999 as a private company. In 2003, it launched its corporate headquarters in the United States, in Reston, Virginia, and then became the Electric Genetics Corporation. However, the name “Electric Genetics Pty Ltd” is still maintained as the name of the company’s R&D arm. This R&D arm is located at the UWC campus, next to SANBI. Ms Broveak-Hide is the chief executive officer of Electric Genetics Corporation and has a staff complement of about 20 people. Prof Hide acts as the chief scientific advisor to Electric Genetics.

4.1 Electric Genetics and the Innovation Fund

Obtaining Innovation Fund support

The activities of Electric Genetics only started in 1998, with a grant application to the Innovation Fund of DST. Prior to the Innovation Fund grant, Electric Genetics played some small role in SANBI’s activities. At that stage, the company was still a sole proprietorship, with the main aim of bringing desktop bioinformatics tools to South African scientists (Engineering News 2001).

In 1998, Prof Hide applied to the Innovation Fund for money, for R&D work to be conducted on the STACK system by a consortium comprising Electric Genetics, SANBI and Silicon Graphics. The task involved was aimed at furthering the development of the STACK system to the point of successful commercialisation on a grand scale, and to enhance its basic features. Electric Genetics, and not SANBI, was the consortium leader and the project coordinators were both Prof Hide and Ms Broveak-Hide. The funding request to the Innovation Fund was motivated as follows:

Knowledge about genetic disease and genes that are targets for disease has been recognized as the most effective way to focus discovery for both medical researchers and biopharmaceutical companies, making the computerized analysis of biological information an attractive investment opportunity. The primary objective of the project is to devise an innovative information system that dramatically improves the user's understanding of the relationship between genes and human disease. The project seeks to achieve this by facilitating integration, access, analysis and visualization of multiple data sources and by providing each user with their own unique perspective on the full range of available information. By understanding the

⁸ A sole proprietorship is a business owned and operated by one individual. It is not considered to be a separate legal entity. It is simply an extension of the individual who owns it. The owner has possession of the business assets and is directly responsible for the debts and other liabilities incurred by the business. The income or loss of a sole proprietorship is also combined with the other earnings of an individual, for income tax purposes. Many small businesses start as a sole proprietorship because they are very easy to establish. A sole proprietorship typically does not have any rules or operating regulations under which it must function. The business decisions are solely the result of the owner's abilities (<http://www.dsjnlaw.com/Business/Soleprop.htm>).

underlying mechanism of disease, researchers pave the way for more effective diagnostics and highly targeted pharmaceuticals, not just for inheritable diseases, but for communicable ailments as well, that attack the disease at its molecular foundation. (<http://www.innovationfund.ac.za/>)

The project was awarded a R4.7 million Innovation Fund grant⁹.

Facilitating technology transfer through the Innovation Fund support

Electric Genetics, when receiving their share of the Innovation Fund funding, immediately established them on the campus of the UWC, next to SANBI. The Innovation Fund support facilitated the effective transfer of the STACK database from SANBI to Electric Genetics, as well as the further development of additional technological outputs:

What happened in the history of the project is that the academics [SANBI] did almost like a proof of concept and produced the database [STACKdb] and produced, I think, one or two updates of the database. When we took over the development and the production of the database, we completely rewrote the software that's used in the production process. Then that became a second product [stackPACK]. That product was sold to commercial and given free to academic users. (Tania Broveak-Hide, interview)

According to a press release by Electric Genetics in 2000, stackPACK has existed for some time in the form of an academic code developed at SANBI. It was re-engineered by Electric Genetics, as part of the Innovation Fund grant, into a “robust object-oriented system, with a strong focus on data management and accessibility through visualization tools” (EG 2000). Postgraduate students, paid through the Innovation Fund grant, also assisted in the effective transfer of the STACK technology to Electric Genetics:

Postgraduate students worked on the project over the course of time that SANBI was developing the database. Then when Electric Genetics took over the commercialisation and we have always been located here within this lab ... so we have used students as ad hoc or contract employees as was necessary. So often we had testing of the system, we wanted to ask people what their experience is with the interface [] So it's getting real-life user input on one hand and also contract labour, and on the other hand skilled workers in the field. We used both of that quite a bit and we have employed students. At the very early stages we would employ them on small short contracts to do work, and then later on we pick up quite a number of the SANBI students as staff members. (Tania Broveak-Hide, interview)

As we will see in section 4.2, Electric Genetics serves as a stepping-stone for many graduates in bioinformatics in the country.

⁹ A point of clarity: The title of the IF funded project was: “Human disease – a genomic perspective”. This comprises the core of what can be referred to as the STACK project. The STACK project, however, is somewhat broader than the IF funded project, because work on the STACK system already started in 1996, when SANBI was launched.

The return on the investment

STACK was one of the very first projects funded by the Innovation Fund, with the result that the Fund largely maintained a hands-off management approach. In addition, the intellectual property issue was never dealt with in detail. Nevertheless, the Innovation Fund is expecting a return on its investment and Electric Genetics is currently negotiating with the Fund about what is reasonable.

Issues about [intellectual property] and return on the investment were very unclearly defined and they're raising their heads now and it still is unclear, they cannot clarify for us what the return, sort of royalty, means. So we don't know if it is a burden or not. So far it has not been a burden at all. We found it very clean working with them but then we were able to deliver on time for all of our deliverables for the project [] They are asking us for a share of the cake now. But they seem to be quite flexible in their negotiations. (Tania Broveak-Hide, interview)

4.2 Electric Genetics and its relationship to UWC and SANBI

Electric Genetics and UWC

UWC has a 1% shareholding in Electric Genetics. The other 99% are split up among the investors in the company. Prof Hide owns a large number of shares, as one would expect for having created the company along with his wife. He himself managed the spin-off process, together with Ms Broveak-Hide, because UWC did not have a structure in place to assist with the commercialisation of intellectual property:

The reason that we did the spin-off was because we had to deal with commercial issues and I've had a lot of experience in both the academic and commercial bioinformatics and I knew that if I intended, for instance, to try and spin it off out of my lab I'd had to do it by myself. The university doesn't have the infrastructure and the university's own technical transfer intellectual property management is basically non-existent. (Win Hide, interview)

According to Prof Hide, UWC originally was suspicious of Electric Genetics but quickly saw the benefit of having a commercial company on campus. Apart from a 1% shareholding in the company, UWC was also allocated the intellectual property of the project:

There were requirements and a memorandum of understanding with respect to intellectual property and that was established. And what was done was that the intellectual property for this particular project was owned by the University of the Western Cape. And it was not up for discussion as a part of that project. (Win Hide, interview)

However, Electric Genetics, when becoming a corporate enterprise in 2003, purchased the intellectual property from the university. The reason was that Electric Genetics was in the process of obtaining venture capital funding¹⁰ from Bioventures¹¹, and the latter only invests in companies that have proprietary technology. In exchange for the intellectual property, the UWC received a combination package, which, among others, involved cash:

Electric Genetics has paid, I recently presented a cheque for seven hundred and fifty thousand rand to the university and part of that was to purchase the intellectual property and ownership of the STACK project. So I think that's very positive. (Win Hide, interview)

By May 2003, the UWC has already received close to R1.5 million from Electric Genetics (Business Day 2003), which excluded the R750 thousand referred to above. To a certain degree, the commercial success of Electric Genetics can be ascribed to the close working relationship between SANBI and Electric Genetics, as well as to the fact that the company is located on the campus. According to a press statement by Ms Broveak-Hide:

Not only does the relationship bring significant royalty income to the university, but we believe firmly that this proximity of academic and industry efforts has been instrumental in ensuring the company's products are technologically ahead of the curve in the fast-moving discipline of bioinformatics. (Mining Weekly 2001)

Prof Hide elaborates:

Normally bioinformatics companies don't site on academic campuses and there aren't that many bioinformatics companies anymore because it's not a very good sales model, ok, business model, but this particular company [Electric Genetics] is affected because frankly they can make the product cheap, because it's developed with high expertise in South Africa where the career costs are low. But to be on campus is an advantage to them because they pay very low rent. So they save, you know, they save on rent, they are next to an academic centre of expertise, they have access to our influence, they have access to the university infrastructure and it's the correct environment to attract very intelligent, very motivated developers, cause they can't attract them with a career path and high salary. (Win Hide, interview)

According to Prof Hide, there is a strong possibility that, as the company expands, Electric Genetics eventually would move off campus. However, he reckons they will always keep a few product developers on campus. He however sees a potential negative aspect in the physical proximity of academia and business because it could result in the culture of business evaporating. More specifically, that:

The [business] people are not as professional because they're mixing with students all the time and frankly I think that's a bad thing because,

¹⁰ Venture capital is money provided by professionally managed organisations that invest alongside management in young, rapidly growing companies that have the potential to develop into significant economic contributors (<http://www.indiainfo.com/bisc/veca/ch02.html>).

¹¹ Bioventures is South Africa's first biotech venture capital fund (an R80 million fund), which was launched in 2001 by Gensec Bank and Real Africa Holdings. These two enterprises jointly manage the fund and are also co-investors. Other investors in Bioventures are the Industrial Development Corporation and the International Finance Corporation (<http://www.bioventures.co.za/>).

one thing, if you're gonna be a successful business ... you have to be very hard and very professional and none of those things are strong enough. (Win Hide, interview)

Electric Genetics and SANBI

The first relationship between Electric Genetics and SANBI is a very personal one, because of the husband/wife team combination. Prof Hide sees this as a conflict of interest but, simultaneously, prefers to concentrate on their combined skills and experiences, to the advantage of both SANBI and Electric Genetics:

So there we have in effect a conflict of interest, we declare it. And I'm very happy to say that as long as we openly declare it, it's positive. The reason this has been successful is that both of us have worked extensively in Silicon Valley in the United States. We know how to commercialise things and we know how to work with academics to generate things, which are useful, and those two keys have allowed us to position the market correctly and to work with the local scientists and academics. (Win Hide, interview)

To solve the conflict of interest he resigned as a director of Electric Genetics and has no more input into the business or product development designs of the company:

And that's on purpose because it's a lot more difficult to be effective if you have a conflict of interest. So I take seriously my role as scientific board member and senior scientific advisor to the company. So in issues of science I am consulted and that's the relationship. (Win Hide, interview)

Thus, the core of the relationship between SANBI and Electric Genetics is a professional science/business one. Electric Genetics has the first option to commercialise SANBI's R&D outputs and, in exchange, must provide SANBI with a free product and technical support:

Electric Genetics has the first rights of refusal on any intellectual property developed by SANBI, excluding that which has a pre-existing agreement or another agreement with another funder. For that Electric Genetics provides us with the technical support and free products and it also markets, you know, stuff that sell well for the university and the university gains one percent. (Win Hide, interview)

The company has no say in the identification of projects for students to work on. It appears from the interview with Prof Hide and various press releases that Electric Genetics does not fund SANBI projects. They commercialise it. Prof Hide and/or the source of funding determine the kind of projects that students should work on:

Electric Genetics cannot influence in any way what we do [] it doesn't have any influence on our day-to-day activities [] On occasion Electric Genetics has sponsored the salary of a student and that student has done something, which is useful to Electric Genetics, but we haven't done that for a long time. They sponsored a post-doc a number of years ago to develop a kind of computer science ontology. (Win Hide, interview)

Although Electric Genetics does not fund students, it provides SANBI graduates with an opportunity to gain experience in commercial bioinformatics. Therefore, Electric Genetics

often serves as a commercial testing ground for many graduates. This was also the case with the commercialisation of the outputs of the STACK project.

Quite often the SANBI students are considering a career in commercialised bioinformatics, they test that ground at Electric Genetics and then they move [] and many of them have moved on to other positions overseas. A lot of people when they finish graduate school they are unsure whether to go with the academic route or the commercial route. So they give it a try and if it doesn't work out, we generally work with them on six to twelve month contracts with the understanding that they are moving on. They give it a try. If they want to go back into academics and apply for a postdoc, they can. If they want to move to another commercial organisation or stay with us they also can. (Tania Broveak-Hide, interview)

An important aspect of the relationship between SANBI and Electric Genetics is that SANBI provides the company with product credibility in the form of peer reviewed co-authored scientific articles:

Well, how do you build a competitive counter product if you're sitting in Africa? Credibility. And I'm very proud to say that the credibility of the company is enormous and that is because it simply does not do anything but provide an excellent product that is scientifically peer reviewed. On occasion we write papers with members of the development team [of Electric Genetics] and those papers become published in very prestigious journals, with the result the company's product is peer reviewed. Everybody's looked at it. (Win Hide, interview)

SANBI also co-published with Electric Genetics on the STACK project. According to Ms Broveak-Hide:

The original STACK publication came out toward the end of the academic phase and around the time that it was being passed over to Electric Genetics. And generally this is a style we like to follow. In our field scientific credibility is very important for adoption. There are so many choices for users and they don't know how to effectively judge new technology. They often go by peer review. And in all the cases of products that we launched we had an academic collaborator [] So we use that peer-reviewed publication as an anchor for promoting the product with the clients. And STACK, the first [] it turned out that the first STACK paper came out about the time we were commercialising, and then there was a second [] there was one just before and one shortly after we commercialised the product. (Tania Broveak-Hide, interview)

The two articles referred to above were respectively published in 1999 and 2001. The details are as follows:

- ◁ Miller RT, Christoffels AG, Gopalakrishna C, Burke J, Ptitsyn AA, Broveak TR & Hide WA (1999) 'A comprehensive approach to clustering of expressed human gene sequence: The sequence tag alignment and consensus knowledge base.' **Genome Research**, 9(11):1143-1155
- ◁ Christoffels A, Van Gelder A, Greyling G, Miller R, Hide T & Hide W. (2001) 'STACK: Sequence Tag Alignment and Consensus Knowledgebase.' **Nucleic Acids Research**, 29(1):234-238

Lastly, SANBI operates at the forefront of international developments in bioinformatics. Through Prof Hide, the institute is intimately linked to various networks and research groups. Thus, the fact that Prof Hide is the chief scientific advisor of Electric Genetics means that:

They become aware of academic happenings, which they wouldn't normally hear about. And things that we get involved in that look like they're going to become productised, they have earlier access to purely by the fact that they know what's going on. So they can approach their technology officers overseas and say look we're interested in this particular thing and, you know, the discussions can happen. (Win Hide, interview)

4.3 Transfer of STACK from Electric Genetics to commercial and academic users

Electric Genetics, when it started marketing the STACK products, primarily targeted pharmaceutical companies and large biotech companies.

The potential users were primarily the American market and secondarily the Japanese market because these were the two largest markets in the world, and in terms of biology, in actual fact, in terms of gross national product anyway, I think. Certainly our users were biotechnology companies and pharmaceutical companies in the States and the same in Japan. (Win Hide, interview)

All commercial users must pay. They can purchase the STACK products directly from Electric Genetics or from a network of international distributors.¹² Their use of either STACKdb or stackPACK is subject to an extensive licence agreement, which must be signed by an authorised signatory. However, only about 25% of Electric Genetics' user base comprises commercial users. The rest are academic users. In addition, only about two-thirds of the commercial users bought the product(s) through targeted sales efforts.

Academic users do not pay for any of the STACK products. The reason is two-fold. On the one hand, being a small company from Africa, Electric Genetics felt a strong obligation to further genomics research at academic institutions. On the other hand, they realised that by attracting as many as possible academics to a free high quality commercial product,

¹² Electric Genetics also has a sales office in the United States. This was made possible by a R10 million investment in the company by Bioventures, in 2003. Thus, through the investment, Electric Genetics could expand its sales and marketing efforts (Business Day 2003).

they would generate a large user base to sell additional products to in future. Thus, by not charging academics for the STACK products, Electric Genetics was executing a foot-in-the-door marketing strategy. Underlying this strategy was a realisation that there are only a few bioinformaticists in the world and that these people change quite rapidly between academic and commercial bioinformatics. Academics often go into commercial science and students, once graduated tend to move into commercial enterprises. By providing the academic market with free STACK products, Electric Genetics effectively facilitated the transfer of the technology into the commercial sector. In turn, the company profited because a commercial licence (which involves payment) is required for application outside the academic sector.

Academics can download the products from the Electric Genetics website once they have registered and agreed that they would not distribute the product to any commercial partner. Generally, there are two types of interaction between Electric Genetics and the academic users. The first starts when a potential user is interested in the system. The user interacts with the Electric Genetics' website, primarily to check out the system and to download the product(s). During that process, Electric Genetics verifies that the potential user is indeed an academic or non-profit user. The user is then sent the access keys for the software, together with detailed installation instructions. More often than not, the users struggle with installing the software and need to interact with Electric Genetics in that regard. Once successfully installed, the contact lies down. The second type of interaction, according to Ms Broveak-Hide:

... [happens during] talks to published papers on research that was completed using the product or at least in part using the product. And we had ongoing interaction with quite a few of those researchers who come to us. They want to know what the parameters are if they want to publish using our data or software, alerting us that these publications are happening. That kind of ties in as well with conferences that we attend, I would say bioinformatics conferences. A lot of posters and presentations are given that involve data that was processed using stackPACK and we also have personal interaction at the conference with people in those situations. (Tania Broveak-Hide, interview)

Thus, transferring the STACK products to academic users also involves a human interaction or networking component. This usually happens at scientific conferences, indicating that the presence of a commercial entity at traditional sites of scientific knowledge dissemination constitutes an important linking mechanism in the science-industry feedback loop. Through its presence, Electric Genetics can become aware of the full range of application of the STACK products and answer queries from actual and potential users. Potential users often are inspired to acquire the product based on the paper and poster presentations given, and by having the product supplier at hand; any expression of interest can be followed up immediately.

Originally, Electric Genetics considered charging academics for customer support because about 90% of its customer support load is from academics.

We considered charging a nominal amount, 500 dollars or something a year, for academics who want support, and we decided against that.

We're rather going to charge a fee for new products that we're doing. So if we get funding to redevelop stackPACK and extend it, it will not be free to academics. But all the people that have committed to the freely available stackPACK will get a very serious discount if they want to buy it. (Tania Broveak-Hide, interview)

Today there are over 400 academic and commercial users of STACK worldwide. The majority are users of stackPACK rather than of STACKdb. The human genome has recently been published, which makes the need for STACKdb somewhat redundant. Users therefore rather go for stackPACK, which processes available genomic sequence information at a very fast rate and in the process allows users to create their own STACKdb type of database. Moreover, stackPACK¹³ can be used to study gene expression in both plants and animals – it is not limited to the human genome.

5 STACK and bioinformatics training and capacity building

Given SANBI's involvement in several general and specialised training courses in bioinformatics, the STACK technology serves as a platform for bioinformatics capacity building by various routes. Some examples will be given.

The first is the structured MSc bioinformatics programme that SANBI has been presented since 2002. A research project is compulsory for these masters' students, apart from 7 taught modules. As part of the activities of the MRC/UWC Bioinformatics Capacity Development Research Unit, SANBI also serves as a host for MRC research training internships. This mentorship programme is open to black candidates with a four-year degree or equivalent, or a master's degree. These candidates are appointed on a 12-month contract at SANBI and become part of the institute's ongoing research projects. The focus is on hands-on training (<http://www.mrc.ac.za/>). Through the structured MSc bioinformatics programme and the MRC research training internships, various postgraduate students have been exposed to the workings of STACKdb and stackPACK.

In 1999, Prof Hide co-presented a tutorial on EST clustering, using STACK, at a prestigious international bioinformatics conference, the conference of the International Society for Matrix Biology (<http://www.ismb.org/>). It normally is regarded as very competitive to present a tutorial at this conference, as the number of applicants for a tutorial is about ten times the number of tutorial slots available.

Since 2002, SANBI annually presents a two-week course as part of the Regional Training on Bioinformatics Applied to Tropical Diseases in Africa. For instance, in 2002, fifteen scientists from seven African countries were trained in stackPACK, which was provided

¹³ Electric Genetics is currently looking at re-implementing stackPACK to tie in more tightly with the needs of existing and potential users. According to Ms Broveak-Hide, many plant genome projects don't involve a genome sequence like the human genome sequence. Plant bioinformaticists are therefore reliant on EST information and very keen to use stackPACK. In addition, there is a move towards using the output of stackPACK to feed proteomics. Proteomics is a new field of study that looks at the protein complement inside an organism. Proteomics experiments however lack specificity. In this regard, stackPACK can be used to a great effect to make proteomics experiments more specific and to produce higher quality results.

free of charge by Electric Genetics. Moreover, selected participants were allowed to take the desktops home, together with the software loaded on it (EG 2002). The United Nations Development Programme sponsors the course, in cooperation with the World Bank, and the Special Programme for Research and Training in Tropical Diseases of the World Health Organisation.

The **National Bioinformatics Network** (see Section 2.3) offers different workshops on Bioinformatics as part of its national capacity building initiative. These workshops, which extend over a 10-week period, are held at SANBI. Prof Hide is responsible for a standard bioinformatics module, where EST clustering and the STACK technology form part of the focus. Electric Genetics also participates in and has taken advantage of the workshops that the NBN presents. According to Ms Broveak-Hide:

... everyone on the [Electric Genetics] staff attended at least one of those courses. And they're exceptional because they bring in top trainers from around the world who are real experts in those specific areas of expertise. So we have the chance, through the NBN hosting that training course, to be trained ourselves and to interact with a lot of the trainers who are here ... academics that would otherwise be difficult for us to access. (Tania Broveak-Hide, interview)

Thus, apart from contributing to national capacity in bioinformatics, the NBN also serves as a way of bringing Electric Genetics in close contact with the most prominent bioinformaticists in the world. This has obvious implications for the dissemination of STACK within the international science community.

Lastly, SANBI also hosted a **bioinformatics service component** on its website, where the institute had a large server of bioinformatics tools that people from South Africa could access. Electric Genetics made the STACK interface freely available on that server for academics.

6 STACK and scientific discovery

The STACK technology is used in collaborative research efforts for discoveries in “local” and other diseases, such as diabetes, tuberculosis, malaria and HIV/AIDS. Among others, it involves the placement of the disease on the genome. For that reason, stackPACK and STACKdb have also been called strategic drug-discovery tools.

Three examples of such scientific discoveries with implications for drug treatment and development are:

◀ A gene that causes blindness.

In 1999, Prof Hide, together with a group of scientist from the University of Texas Health Science Centre, discovered a gene that causes *retinitis pigmentosa*, one of the most common forms of blindness. The gene, known as RPI, contains the mutation responsible for the disorder (Shapshak 1999).

◀ Genes that can be found in malaria.

In 2000, an MSc student, Mr Rahlston Muller, used STACK to collect publicly available gene fragments for different species of the pathogen that causes malaria. These he put into longer representations of the genes. With the aid of computer algorithms, he could identify the specific genes that play a role in malaria (Engineering News 2001).

◀ Understanding of the TB organism.

In 2002, a PhD student of Prof Hide, Dr Junaid Gameldien, published an article reporting that the TB bacterium has stolen genes from plants and fungi. A subset of the poached genes allows the TB organism to change the steroid balance in humans. As a result, sex steroids are broken down, which produces a weak immune response (Moodie 2002).

Each of these discoveries, as well as many others, has its line of further development. The extent to which each discovery has been taken up by drug companies is unknown and the investigation thereof an almost impossible task. The main observation is that the STACK technology can be used to unveil disease related genes, which, in turn, can be targeted with new or improved drugs and vaccines. Already in Section 4.3 we have seen that especially stackPACK enjoys wide application in both academic and commercial bioinformatics, as is evident in the paper and poster presentations at international science conferences.

7 Concluding remarks

In the emerging field of bioinformatics in South Africa, the close association of SANBI and Electric Genetics represents a major success story. In less than a decade SANBI has established itself as a leading research institute in bioinformatics in the world and its director, Prof Hide, has been rated by the South African National Research Foundation as an internationally acclaimed researcher. Electric Genetics, on the other hand, excels in the commercial sense. In 2000, the company won a Business Day Technology Top 100 reward in the Research and Development category for excellence in the design and development of new technology. At the time of the reward, STACKdb and stackPACK were the company's two main product outputs.

This case study highlighted some factors in the work relationship between SANBI and Electric Genetics that, arguably, facilitated the transfer of the STACK technology from SANBI to Electric Genetics, and from Electric Genetics to the users of the technology. The support of the Innovation Fund was mentioned, as well as the fact that Electric Genetics had employed ex-students of SANBI to work on the STACK project. The latter ensured some continuity between the academic and commercial stages of the project.

There also appears to be a blurring of the boundaries of science and business in the field of bioinformatics in general. Prof Hide himself is a good example, having shifted from being a director in the computer industry in Silicon Valley to directing an academic institute in South Africa, while maintaining a shareholding interest in a bioinformatics spin-off company. Electric Genetics acted upon this interchange of academic and commercial bioinformaticists by providing the STACK products free of charge to academic bioinformaticists. Through the spontaneous mobility of academics, the company managed to infiltrate the heartland of commercial bioinformatics. Thus, one could argue that specific characteristics of the field of bioinformatics played a role in the transfer of the STACK products from Electric Genetics to the users.

Moreover, apart from SANBI's and Electric Genetics' physical proximity at UWC, three further arrangements point to a blurring of traditional science/industry boundaries in their work relationship. These three arrangements created favourable circumstances for the effective transfer of the STACK technology. The first is the co-involvement of SANBI and Electric Genetics in peer-reviewed scientific publications. The purpose thereof, in the case of SANBI, is to strengthen academic reputation and, in the case of Electric Genetics, to provide the required credibility to the products that were conceptualised by SANBI and commercialised by Electric Genetics. A second indication of the blurring of science/industry boundaries in the relationship between SANBI and Electric Genetics is the latter's presence at international science conferences. This largely accrues from the fact that publication requires presentation, as well as the company's strategy to make itself visible among current and new clients. Thirdly, the respective heads of SANBI and Electric Genetics are husband and wife, which inevitably foster closeness between the partners, apart from a mutual interest and commitment to each other's success and career prosperity.

The reason for dwelling on Prof Hide and Ms Broveak-Hide's marriage is the critical role of trust in commercial activities. According to Liebeskind & Oliver (1997), collaborative relationships between parties with commercial interests require a much deeper form of trust than normal academic research relationships. In the case of SANBI and Electric Genetics, the trust is primarily on an inter-personal level and this unavoidably spills over to the inter-institutional level. Moreover, the fact that the leaders of the two organisations are married implies that a resolution must be worked out when there is disagreement, and that the resolution must benefit both parties. Ms Broveak-Hide acknowledges the role that being married plays in the unstrained relationship between SANBI and Electric Genetics, as well as the role of other factors, such as their sharing of resources and the necessity of local collaboration in bioinformatics:

There are two things I think that are rather critical in forcing us to think of mutually beneficial resolutions to all of our problems. One is the fact that Win and I are married – I know I have to go home with Win at the end of the day! – and the other is the fact that we co-exist physically here. There is a nice symbiosis between the two organisations. We're dependent on SANBI and the university for space, they're dependent on us for some resources; we share computers, we share a system administrator. So there are some shared resources, which we both contributed to. We realise you can't just throw your toys and walk away from that. Whereas if it is purely transfer technology only, or a marketing type of relationship, then I

think there are times in the past where we may have walked away from the relationship. I mean, the other third quality that forces us to work together effectively is that there are very few bioinformatics people in South Africa and if we want to have collaborators, it makes sense to have collaborators in your local area. And these guys [SANBI] are the only bioinformaticists in the local area. (Tania Broveak-Hide, interview)

Lastly, what should not be forgotten is that, presently, there exists a national receptiveness for bioinformatics in South Africa. Bioinformatics has been presented as an enabling technology platform for biotechnological progress in various policy-related documents. The most pertinent of these documents are the National Biotechnology Strategy (DACST 2001), the National Biotech Survey (NBS 2003) and the strategic review of and forecast for biotechnology platforms (Du Preez, Morris, Walwyn & Webster 2003). Bioinformatics, especially applied to the identification of drug targets and the examination of pathogen-host interactions, is one of ten top technologies required to improve health in developing countries. On the human supply side, bioinformatics has been articulated as an area of biotechnology that experiences a shortage of skilled scientists, particularly MSc and PhD graduates (NBS 2003:45, 54). Hence, the country has seen the introduction of the NBN to develop capacity and support services in bioinformatics. Arguably then, without such an enabling policy environment the quest for bioinformatics and its tools, like STACKdb and stackPACK, would not have entered the public discourse at its current pace.

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CASE STUDY 4

FRICION STIR WELDING

The influence of weld travel speed on a friction stir welded joint, in 5083 h321 al plate

A research project led by Dr Danie Hattingh of the Manufacturing Technology Research Centre, Faculty of Engineering, Port Elizabeth Technikon

by Leisl Bowers



ESAB SuperStir™ installed at Marine Aluminium Aanensen & Co. AS. Photograph courtesy of the ESAB website [<http://www.esab.com/index.asp?item=91045>]

CONTENTS

Abbreviations	176
1 Introduction	177
2 Project description and organisational context	178
2.1 Organisational history	179
2.2 Project description	187
3. Key descriptors of the Friction Stir Welding project	190
3.1 Project objectives	191
3.2 Sources of funding	191
3.3 Project outputs and deliverables	192
3.4 Dissemination strategies	192
3.5 Positives	193
4 The knowledge production environment and process	194
4.1 Research category of the project	194
4.2 Research problems	194
4.3 Nature of research collaboration	195
4.4 Interactions with users	196
4.5 Linkage mechanisms	196
5 Mode of knowledge utilisation	196
5.1 The intended users	196
5.2 Utilisation strategies	197
5.3 Examples of utilisation	197
5.4 Matters of intellectual property and license agreements	197
6 Concluding observations: Lessons learnt from this case	197
6.1 Research transformation	197
6.2 Government-industry-academic relationships	198
6.3 International co-operation.	199
6.4 Communicating research	199
6.5 Dissemination	199
6.6 Research isolation	199
6.7 Technology stations	199
6.8 Slow research uptake by industry	200
6.9 Research in the interest of national goals	200

Data sources	201
Face-to-face interviews	201
E-mail responses to additional questions	201
Questionnaire	201
Publications and documents	201
Websites visited	201
 Appendix: Career profiles of FSW team members	 202

Abbreviations

ACTS	Automotive Components Technology Station
DACST	Department of Arts, Culture, Science & Technology
DST	Department of Science & Technology
FSW	Friction Stir Welding
MoU	Memo of Understanding
MTRC	Manufacturing Technology Research Centre
NACI	National Advisory Council on Innovation
NRF	National Research Foundation
PET	Port Elizabeth Technikon
PMU	Project Management Unit
RNA	Research Niche Area
SMME	Small, medium and micro enterprise
TDRP	Technikon Development Research Programme
ToR	Terms of Reference
TSP	Technology Station Programme
TWI	The Welding Institute
URDP	University Research Development Programme

1 Introduction

Historically, the development of the manufacturing sector in South Africa has been one of the main business undertakings by various government departments in the country. The government's interests in the development and expansion of the manufacturing sector led to the establishment of a number of state-owned enterprises including Iscor (the Iron and Steel Corporation) and Eskom (the Electricity Supply Commission), both of which have been major actors in industrial transformation and development over the years. Since assuming the reigns of governance in 1994, the new South African government has committed itself to preventing de-industrialisation and to accelerate the growth of the manufacturing sector in the country as one of the main key drivers for economic growth and employment creation (DTI, 2003a). For instance, the manufacturing share of the South Africa economy is growing rapidly as traditional exports – and mining in particular - decline in importance: manufacturing expanded from 39% of all exports in the first half of the 1990s to 51% in 2000. Over the past five years, the manufacturing sector has grown relatively slowly with an annual average output increase of 1.8%. Although considered slow, this growth has been a significant success in avoiding the real threat of de-industrialisation in the country (DTI, 2003a: 15).

One of the successful measures of policy interventions taken by the new government is the introduction of the Motor Industry Development Programme in 1995, which has been key to effective transformation of the automotive industry. The automotive exports now account for 12.8% of South Africa's total exports, increasing three-fold from 4% in 1995. During 2002, the automotive sector was the third largest sector in South Africa's economy, after mining and financial services. It was also the leading manufacturing sector, responsible for 6.3% of the country's gross domestic product (DTI, 2003b:8).

The success of the Motor Industry Development Programme and other related policies led to the formulation of a new policy - *Accelerating Growth and Development: The Contribution of an Integrated Manufacturing Strategy*. Under the *Integrated Manufacturing Strategy*, the government identified five sectors of the economy that have considerable potential for increasing outputs, exports and employment creation, which will receive focused attention from the state. These sectors are agriculture (including food production), tourism, cultural industries and export sectors (including minerals and metals), clothing and textiles, automobiles, agro-processing, and chemicals. There is room for other sectors to develop. In each of these sectors, the focus will be on employment creation, value addition (where technological innovation is critical), production for the domestic market, as well as export growth, small business development and black economic empowerment (DTI, 2003:30).

However, the achievement of these development objectives will not be possible without improvement in the quality of scientific research and the transfer of knowledge on manufacturing technologies. Therefore, key to attaining these developments is the evolving dynamics of scientific research in the higher education sector that could fit into the transformative research agenda and challenges of the funding programmes of funding agencies such as the National Research Foundation (NRF) and some of the demands of the national economy to speed up economic growth and development. As indicated in the 2003 Automotive Industry report by the Department of Trade and Industry (DTI), South

African industry is supported by several excellent engineering universities, as well as specialised facilities that focus on the automotive industry, including the Automotive Industry Development Centre, the Centre for Automotive Engineering and the Eurotype Test Centre (DTI, 2003b: 46).

The Eastern Cape region of South Africa has a highly integrated motor manufacturing industry. The Friction Stir Welding (FSW) project, located within the research programme of the Manufacturing Technology Research Centre (MTRC) at the Port Elizabeth Technikon (PET), was selected as a case study because it involves both knowledge creation and skills development, and has a good potential for knowledge utilisation in the manufacturing sector of economy. In terms of knowledge creation, the FSW project fits into one of the nine focus areas of the NRF, as well as the new research vision of the PET as an academic institution. The FSW project also has a great potential for contributing to the advancement and application of manufacturing technologies, especially in the automotive and aluminium industries in the country. Therefore, it could also contribute to the realisation of certain of the programmes of then Department of Arts, Culture, Science and Technology (DACST)¹. Examples of these include the Technology Station Programme, through which the PET benefited via the establishment of the Automotive Components Technology Station (ACTS), as well as the new National Research and Development Strategy (NRDS) (2002), which identifies research and technological innovation as a critical area. In addition, a programme such as the Motor Industry Development Programme (MIDP) of the DTI, which has been extended until 2012, could also benefit.

Finally, the potential for knowledge utilisation in industry is more compelling given that the FSW project leader, Dr Danie Hattingh, is also manager of ACTS. Therefore, even though the project was initiated initially through individual efforts put in by Dr Hattingh's research network, it clearly contributes to the transformation of research and human resource development in the country in the future expansion of the manufacturing sector. However, we cannot draw any hasty conclusions without looking at how the history of the project has unfolded over the past two years.

A detailed description of the project's organisational context is provided by discussing the PET, MTRC and ACTS.

2 Project description and organisational context

As stated, Dr Danie Hattingh is the project leader of the FSW project. In order to avoid any possible confusion it is necessary to outline his position within PET, the MTRC and ACTS. Dr Hattingh was an academic (the Head of Department of the Department of Mechanical Engineering) in the Faculty of Electrical and Mechanical Engineering (EME) when the MTRC was established at PET in 1998. Four years later, in January 2002, while still an academic in the Faculty of Engineering, Dr Hattingh started the FSW project. Then in July 2002, ACTS was implemented and Dr Hattingh was appointed as the Manager of ACTS. In this position, he no longer lectures, but remains the project leader of the FSW project and supervises postgraduate students in the Faculty of Engineering.

¹ DACST (Department of Arts, Culture, Science and Technology) split into DST (Department of Science and Technology) and DAC (Department of Arts and Culture) in early 2004

2.1 Organisational history

The FSW research project forms part of the research programme of the MTRC. The history of the MTRC will be presented against the background of Port Elizabeth Technikon. A close co-operation exists between the Automotive Components Technology Station (ACTS), which is an institute that offers direct support services to the small, medium and micro enterprise (SMME) sector and the MTRC, and some background information on this particular technology station will be presented as well.

The Port Elizabeth Technikon

The origin of the Port Elizabeth Technikon (PET): PET originates from the oldest art school in the country founded in 1882 and was formerly known as a College for Advanced Technical Education. It was situated in Russel Road, in the Central Business District of Port Elizabeth. In 1974 the College moved to Summerstrand and in 1979, became the Port Elizabeth Technikon. In 2003 it was the largest tertiary educational institution in the Eastern Cape Province with over 10 000 students enrolled and more than 700 staff. It had three campuses in Port Elizabeth and one campus in George (Southern Cape).

The primary mission of the PET was to provide higher education and training to meet the demanding and constantly evolving, career-specific needs of the market place and especially industry. Flexibility, adaptability and creativity are part of their educational philosophy (Pieter van Breda, interview, 27 August 2003 & PET Research Manual [<http://www.pet.ac.za>]).

Research at PET: A focus on research within South Africa's technikon is a recent phenomenon. During an interview with Dr Pieter van Breda, the Director of the Unit for Research Development, he explained that there were three phases in the development of research at PET. The first phase began with the development of the Research Committee about 15 years ago. An academic staff member ran this committee on a part-time basis. The committee had very limited funds and its major function involved the processing of application forms of staff members and students for resources from the Research Committee. The second phase began with the increase of both internal and external funds (for example, Centre for Science Development and Foundation for Research Development funding). This led to an increase in the administration that was required for the allocation and release of such resources, which resulted in the establishment of the Unit for Research Development. Phase three represents a paradigm shift where greater emphasis was now placed on the relevance and merit of projects before they are registered and become eligible for funding. By implication, resources were only to be channelled to projects that will contribute to making PET a First Choice Technological University in Southern Africa (PET Research Manual).

The history of the MTRC

The departure point of any development planned at PET is based on the vision of the Technikon becoming the first choice technological university. A step in this direction was in changing the original organization of the different faculties at the Technikon, in which each faculty worked on its own, doing its own research separate from the other faculties. The aim of the management of PET was to replace the existing organisation with one where people from different disciplines would not only feed into one collaborative

research project (do integrated, multi-disciplinary research), but where these people would be housed in one venue, a venue such as the MTRC.

The origin of the MTRC: In understanding why the MTRC was established, one would have to look at why the focus was to be specifically on manufacturing. As already mentioned, the Eastern cape Region has a highly integrated motor manufacturing industry:

As a result, small companies joined the discreet parts manufacturing sector. For this reason, the NRF has identified that the Port Elizabeth Technikon's activity area of Manufacturing Technology Expertise Development should focus on the manufacturing sector for research purposes with specific focus on small and medium-size manufacturers in this industry. In order to achieve this objective, a closer relationship needs to be established with the motor and component manufacturers in the area. (MTRC 5-year plan for Niche Areas of NRF Technikon Research Development Programme, 2002:2).

Thus in 1998 a physical home was created for the Manufacturing Technology Research Niche Area at PET with the establishment of the MTRC.

This particular Research Niche Area (RNA), the Manufacturing Technology Research Niche Area, which is part of the NRF Technikon Research Development Programme (TRDP) (Five-year plan), falls within the PET's

[] Faculty of Electrical, Industrial and Mechanical Engineering and will therefore report to the Faculty Research Committee, which takes responsibility for the interval evaluation and approval of all projects proposals. The Faculty Research Committee also reports to the CRC of the PET with respect to final project approval, funding and progress (MTRC 5-year plan for Niche Areas of NRF Technikon Research Development Programme, 2002:17).

Therefore the FSW project fell within the Manufacturing Technology RNA that falls into one of the NRF's nine focus areas - Economic Growth and International Competitiveness.

The first step to establishing the MTRC was achieved by sending a team, in late November 1998, to visit the Nan-Yang University of Technology in Singapore since this university was built on the same model that PET was interested in implementing with the MTRC. This team consisted of Dr Danie Hattingh – FSW Project Leader and Manager of the Automotive Components Technology Station (ACTS), Prof Theo van Niekerk - Dean of the Faculty of Engineering and Prof Eugene du Preez - the Dean of the Faculty of Computer Studies. The trip to Singapore, as well as the initial establishment of the MTRC, was financed through funding from the Central Research Committee (CRC) and through NRF funding that was allocated to the development of the Manufacturing Technology RNA.

Research in the MTRC: The Head of the MTRC is and the Research Manager is Mrs Annelize Els-Botes, a senior lecturer in the Faculty of Engineering. Her research is centred in the field of Materials and Laser Technology. The MTRC is not only a research centre, but a place where students can feel at home, can place posters, have weekly

colloquiums, etc. It was decided that since manufacturing technology cut across a wide spectrum, it could form an umbrella under which different disciplines, for example, engineering and computer science, could work. The MTRC was then further developed with the recruitment of students and obtaining industrial robots.

As already mentioned, the MTRC was the home of the Manufacturing Technology RNA. The main research objective of the RNA, as specified in the 2002 MTRC 5-year plan for Niche Areas of Technikon Research Development Programme compiled for the NRF, is “to integrate materials and manufacturing research” and the specific research objective is the “research and development of a Friction Stir Weld (FSW) process for the South African manufacturing industry”. Thus, the FSW project was researched and developed in the MTRC. Furthermore, the research portfolio of the MTRC has been in two fields of research, viz. materials research; and electronics and intelligent control research both of which reflect the existing expertise in the Centre. According to Dr Hattingh:

This project really gave us the opportunity to now put those two fields of expertise into one project because it is a manufacturing process that needed control. So it fits slap bang into the already existing expertise. (Danie Hattingh, interview, 27 August 2003)

International links of the MTRC: These international links of the MTRC include those with “Fachhochschule Ingolstadt and Braunschweig/Wolfenbüttel, they are Universities of Applied Sciences, same as our Technikon” (Theo van Niekerk, e-mail, 25 August 2003).

The international links formed with the MTRC came about due to the interactions of the individual lectures with specific overseas research institutes. The results of these interactions included academic and student exchange:

There have been over 50 students as part of the exchange. We most probably had over 10 staff members (visiting already). At the moment there is a visiting lecturer here now. The staff members come here for about six weeks, but our staff goes over there for three or four months. I might be looking at a sabbatical, which is part of the link that I’m going on now, to set up a sabbatical for me for next year for 3 or 4 months and to see how can I put my research with some of the work that they are doing. (Theo van Niekerk, interview, 27 August 2003)

The history of ACTS at PE Technikon

This section will cover the formation of the Technology Station Programme (TSP), its implementation at PET as ACTS, the international collaborators of TSP, how ACTS is managed and the relationship between ACTS and the MTRC.

The development of TSP: To a greater degree, technikons are engaging in direct support services to the SMME sector. These services include “consultancy, testing and quality control, design and product development and customised short term training. Existing equipment is offered for technology demonstration, pilot production and contract production jobs” (Tshumisano Annual Report, 2002:1). The TSP is a programme developed by the Department of Arts, Culture, Science and Technology (DACST) for the

purpose of strengthening and accelerating this mutually beneficial interaction between Technikons and SMMEs.

DACST understood that international cooperation "...would add value by offering access to experience and best practice and at the same time opportunity for peer review and quality assurance, as is practiced with rated academic institutions" (Tshumisano Annual Report, 2002:7). Thus in developing the concept of the technology station, DACST looked for international partners in the field of technology transfer based in Higher Education Institutions and settled on the German model of the Steinbeis Foundation. This model forms part of the "Fachhochschulen" - Universities of Applied Science – that are similar to the South African Technikons (Tshumisano report). Thus ACTS is funded by DACST (DST since early 2004) and the German Agency for Technical Cooperation (GTZ), which is acting as the implementing agency.

The establishment of ACTS at PE Technikon: Through the Industrial Liaisons Department at PET, there was a call for proposals for technology stations by DACST. In the first round in 1998, DACST selected four technikons for the establishment of Technology Stations and in a second round in 2001; PET was one of three technikons that DACST selected for the establishment of a Technology Station. ACTS was positioned inside PET

[] after intense planning and broad consultation with all academics in the Engineering Faculty. This resulted in the development of a restructuring plan for the Engineering Faculty, which incorporated ACTS as an integral part of the Faculty, but still with a large amount of independency. (Tshumisano Annual Report, 2002:3)

After PET submitted their business plan, a total of R 6.1 million was released to the three technikons and operations started at the end of 2001 and the beginning of 2002. The new structure was implemented at the beginning of July 2002 with the appointment of the Technology Manager in the Technology Station. The staff component of ACTS consists of a Technology Manager, three Design Consultants and an Office Manager. It was also determined that ACTS will as a priority involve as many previously disadvantaged students in the projects as possible. This new structure is indicated in the in figure 1, taken from the 2002 ACTS Annual Report.

From this figure (moving from left to right) we can see that the new faculty structure at PET (implemented after July 2002) consists of the Faculty of Engineering – managed by a dean and five Head of Departments (HOD) where each HOD has a departmental Specific Programme and are subject specialists. For example the department of Mechanical Engineering's subject fields are Thermodynamics, Fluids, Machine Design, Mechanics and Mechatronics. Since the new structure has changed its focus to research, a Research Manager (who has a post equivalent to that of an HOD) now manages the MTRC. Also housed at PET is ACTS – managed by the Technology Manager. ACTS on the one hand reports to a Management Committee whose members include, besides others, the Dean of the Faculty of Engineering and the Technology Manager of ACTS and on the other hand to an Advisory Committee which consists mainly of industrial members. ACTS plugs into the MTRC with some overlap, but with different management structures.

Figure 1: New structure of the Faculty of Mechanical & Electrical Engineering

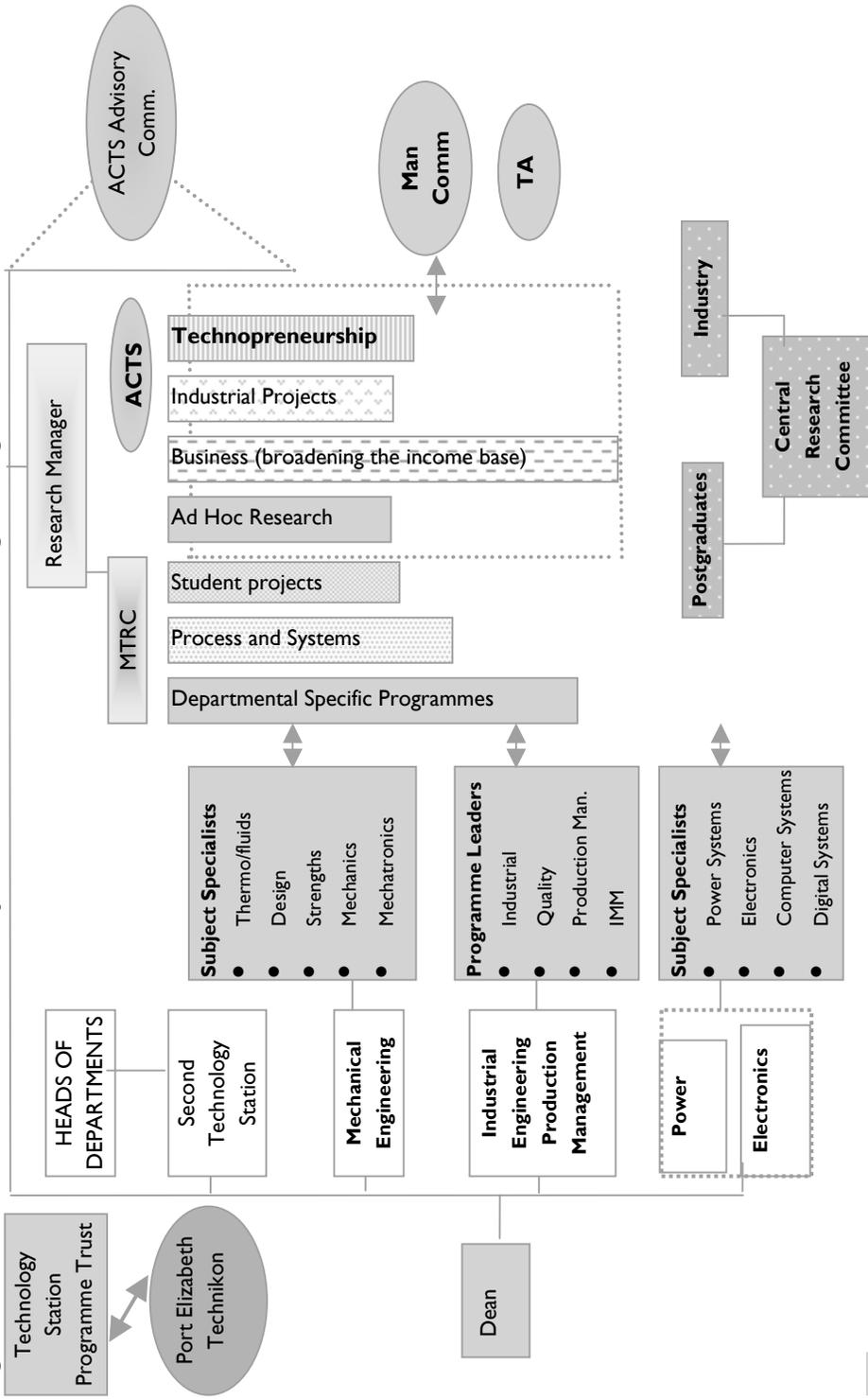


Figure 2: The lines of interaction between the Managers of ACTS

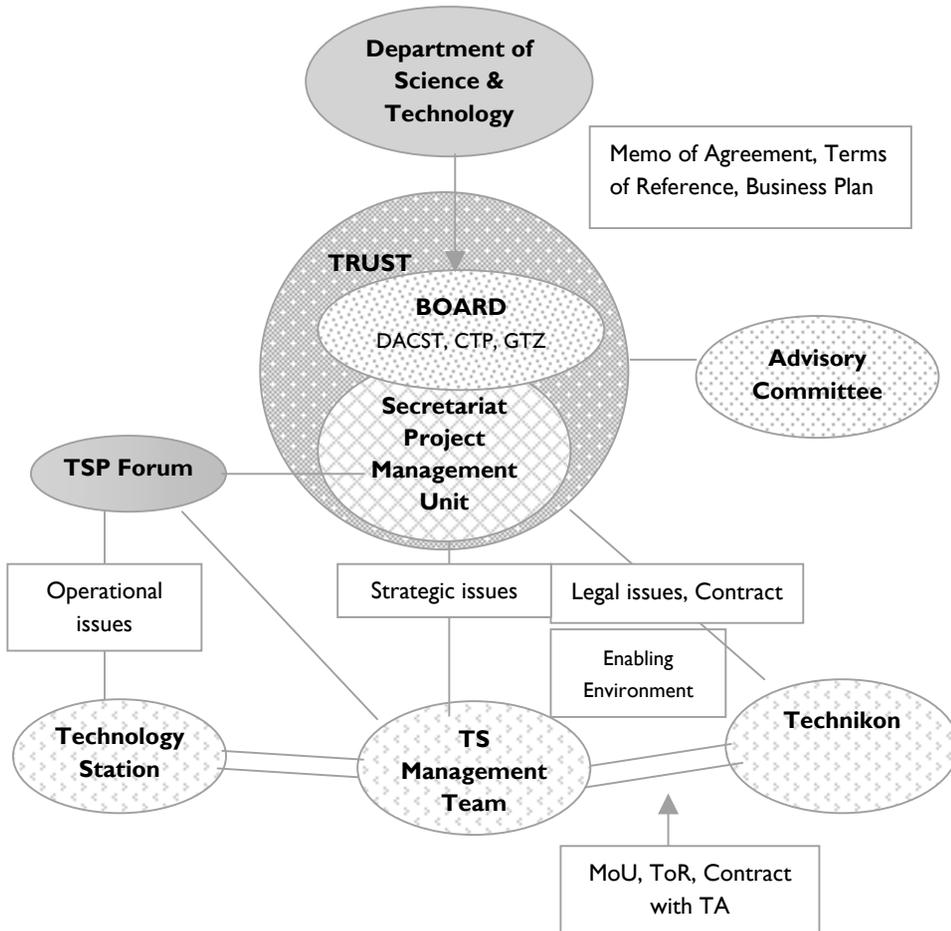


Figure 2 illustrates the lines of interaction and reporting between the Department of Science and Technology (DST), the Trust and its technology stations. ACTS (Technology Station) reports to a management committee (TS Management Team) who in turn reports to a Trust in Pretoria. The committee consists of the Enterprise Development Manager, the Vice-Rector Research and Planning, the Dean of Engineering, the Dean of IT and Dr Hattingh. The founder trustees are DST, German Agency for Technical Cooperation (GTZ) and the Committee of Technikon Principles (CTP) and they as the board, with Secretariat make up the Trust (Tshumisano report). The Advisory Committee to the Trust has a number of National Government Organisation's (NGO) and Industry representatives. Also, each Technology Station has a similar Advisory Committee.

This relationship between the MTRC and ACTS, was explained by Dr Hattingh as follows:

They are two separate entities that are overlapping about 80%. So basically you've just got two different management structures reporting on two different channels. The MTRC has mainly a research and academic

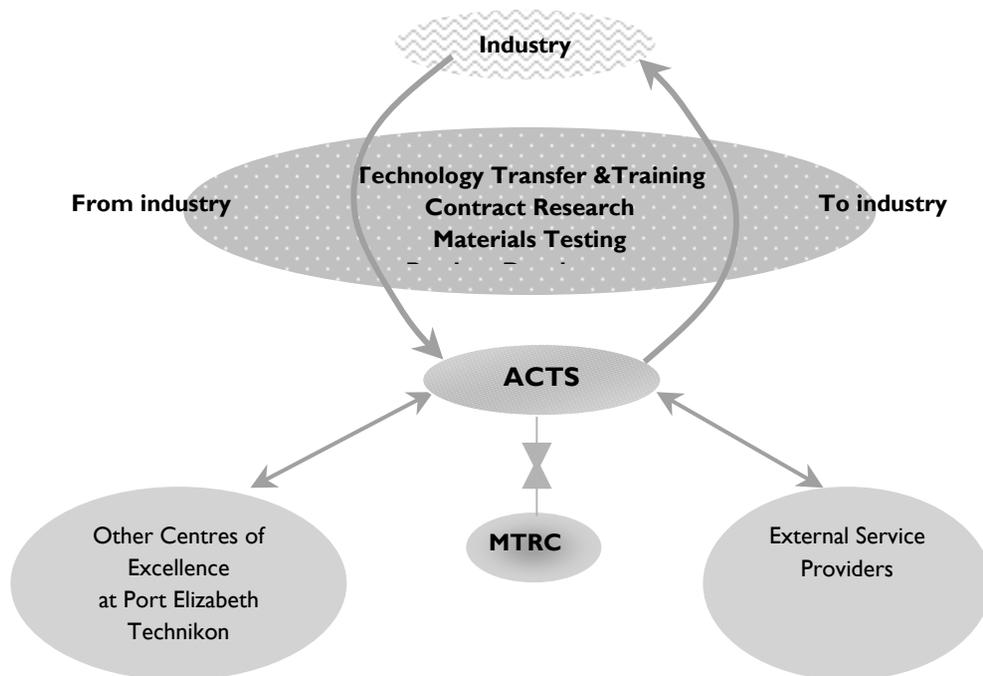
function, and ACTS has mainly a problem solving business function, company or technology transfer function. So the idea is that the technology station does take responsibility for rolling out technologies developed in the research centre, but also to a certain extent to direct the research in the MTRC to be more applied and industry focused. (Danie Hattingh, interview, 27 August 2003)

Dr Hattingh described the existing overlap between the MTRC and ACTS as follows:

The overlap would be inside a research project. You've got an academic and science development side and a problem-solving and design side. So your researchers are not always your best designers for equipment. Whereas at your technology station you sit with excellent design engineers who do it for a living and they can then design equipment. It is just serving industry. If industry comes to you with a problem, you can talk to anybody in the MTRC and they can pass the case on to the TS and if we identify a research problem, we pass it on to the MTRC. So it's having the best of both sides to a certain extent. (Danie Hattingh, interview, 27 August 2003)

The aim of the new structure and the involvement of ACTS in the Engineering Faculty is to “develop support and sustain a world class research centre (MTRC)” and to form “a ‘one-stop’ service centre for all industrial related projects and form the entry point for industry into the Technikon and other providers” (ACTS 2002 Annual report, p3). Figure 3 taken from the 2002 ACTS Annual Report, illustrates this concept. Here we see that the three areas of engineering: Mechanical, Electrical and Industrial form the foundation of and feed into the MTRC. The MTRC and ACTS support each other with expertise, knowledge and experience. ACTS, seen as an external service provider, draws expertise from the three mentioned engineering areas while simultaneously transferring technology and training to Industry and back into the Technikon. ACTS mainly does contract research, materials testing and product development and other technology support – mainly for the SMME sector.

Figure 3: ACTS work flow



What comes out strongly from the figures above is that there has been a noticeable change from research centred around the academic institution, to research that incorporates much more of industry. The new structure enforces the idea that industry has much more say in the research that is undertaken at the academic institution. What are also very noticeable is the importance of linkages and networks between the researchers or producers, industry or users and other stakeholders, such as the government, to ensure the use of knowledge and research.

Figure 1 indicates that ACTS reports to an Advisory Committee consisting mainly of industrial members. The links, interactions and close cooperation between industry, the technology station and the academic research centre are also illustrated. This type of set-up ensures that the research is more applied and industry focused.

Figure 2 shows the connections between the government, industry and the technology station. Due to the fact that the technology station is housed at the technikon, the technology station acts as a communication link between industry, the government and academic research. From the communications between the technology station, industry and the government, the technology station directs the research in the MTRC and, in this way the MTRC is kept up-to-date with the trends within industry and with what knowledge is relevant and useful to the country.

The idea to forge a close link between industry and the technikon and to ensure that research at the technikon is useful to industry is illustrated in the third figure. Here we see

the cyclical nature of expertise, knowledge and experience, as the technology station transfers it from the technician to industry.

2.2 Project description

Nature of the research project

Because Friction Stir Welding is such a technical process, special attention will be given, in the first part of this section, to explain this technique using the simplest of terms.

FSW is a relatively new solid state welding process and is described in the **PE Technikon Impetus** as follows:

To make a Friction Stir Weld, a specially shaped rotating tool with a shoulder and a pin is plugged into the joint line of the two plates to be welded. The shoulder in contact, produces frictional heat that softens the material creating a third body or plasticised region while the pin or probe of the tool stirs the material. This plasticised region is below the melting point of the parent metal and is thus characterized as a solid welding process. The process ensures grain refinement in the weld region which is beneficial to the fatigue life. The controls of process parameters are critical to ensure good weld quality. These may include spindle speed, temperature, Z-force, X-force, etc. (PE Technikon Impetus, 2003, Vol. 10:21)

Dr Hattingh describes the process of FSW as follows:

Friction stir welding (FSW) [] offers high joint quality and good fatigue performance. Other advantages include little, or no, joint preparation, relatively few defects and little requirement for post-weld dressing. In friction stir welding, a cylindrical, shouldered tool with a profiled probe, or pin (slightly smaller in length than the plate thickness), is rotated (typically at around 500 rpm) and slowly plunged into the joint line between two abutting pieces of plate or sheet that are to be joined. The parts must be clamped to prevent the joint faces being forced apart. Adiabatic shear and friction generate heat between the wear resistant tool and the plate. The material softens and flows around the tool as it is progressed along the joint line. Forging occurs under the pressure applied by the tool shoulder, which is inclined at a slight angle (around 2.5°) to the horizontal. The process approximates a solid-state keyhole welding process, in that a hole to accommodate the pin is generated, then filled as the weld is made. (Danie Hattingh, e-mail, 18 August 2004)

The FSW project evaluated the influence of weld travel speed i.e. the advancement in making the weld in millimetres per minute or the distance covered in a set time, on a weld quality of 6mm 5083 H321 AL plate. While 5083 refers to the specific grade of Aluminium Plate, H321 relates to the heat treatment condition in which it is supplied.

Dr Hattingh has categorised the research as applied research and regards this research as “filling in the gaps” since it centred on finding answers to questions within existing research. The research can be seen to be expanding or improving a relatively new existing technology:

[] filling in the gaps that is important, and it must be a new technology. It is applied research. I will definitely only tackle applied research projects, because that is what I believe in as an engineer. Engineers should be involved in more applied research than fundamental research. (Danie Hattingh, interview, 27 August 2003)

Dr Hattingh referred to the FSW project as a multidisciplinary project since it involves “...electronics, materials and mechanical components and you can most probably now also start involving industrial engineering to do time studies and ergonomic studies around developing a new machine and also IT could become involved with the project”.

As the research results were being produced, these same results were being used and applied in industry. It has reached a stage where the research is slightly leading the application:

I think to a certain extent it was applied quicker than what the research was progressing at one stage. So there was a bit of a push and pull scenario from a research point of view. We're now at a point where the research is slightly leading the application and researchers have to move very quickly on solving new problems and new applications. They are welding thin plate now at 6 meters per minute, which is a high speed welding, unheard of 3 months 4 months ago. (Danie Hattingh, interview, 27 August 2003)

The contributions made by the project are centred on generating new knowledge that solves existing problems. Dr Hattingh refers to the project as contributing to a “lot of new knowledge that would solve existing problems around tool design, process parameter control, weld integrity so we definitely made contributions to that...” He summarises this contribution as “adding science to the understanding of the process”.

The FSW team has developed an experimental machine, which monitors a number of variables that occur during the welding process. This machine is of a high calibre since it is seen as one of the more advanced experimental machines in the world. For that reason, a lot of recognition was received for it worldwide. The same team that developed the machine invented the Force Feed Print (FFP), which is a possible future technique for predicting weld integrity. At present one of the team members is looking at the retractable tool pin, another is looking at increasing the Artificial Intelligence (AI) on the machine and the feedback loops on the process side, the student from Plymouth is looking at weld integrity.

The immediate plans of the team is to disseminate the process to the South African Industry by taking it to industrial partners and convincing them of the advantages of using the process.

Project history

The FSW project was initiated in January 2002, but when going into the history of the project, one would have to look at how Dr Hattingh came to learn about the FSW process. Dr Hattingh was in contact with a certain Prof Neil James of Plymouth University, in the United Kingdom, whom he had first met at Wits University and then they renewed their friendship while Dr Hattingh was studying his PhD at Plymouth. It was through this contact with Prof James, and because of his involvement with the research at the University of Plymouth and in France at Grenoble, that Dr Hattingh was introduced to the process of FSW. Prof James did a lot of evaluation work with a British based centre called The Welding Institute (TWI). They are the organisation that invented the FSW process, and they hold the patent rights for the process.

Since 1946, the Welding Institute Ltd has been based at Great Abington near Cambridge and is an independent research and technology organisation that:

[] provides industry with engineering solutions in structures incorporating welding and associated technologies (surfacing, coating, cutting, etc.) through information, advice and technology transfer, consultancy and project support, contract R&D, training and qualification and personal membership. It is internationally renowned for bringing together multidisciplinary teams to implement established or advanced joining technology or to solve problems arising at any stage - from initial design, materials selection, production and quality assurance, through to service performance and repair. (<http://www.twi.co.uk/>)

Also important is the academic involvement that TWI sought and encouraged. According to Dr Hattingh, TWI was initially a government-funded organisation, but has since become an independent institution. They concentrate on developing new welding techniques and technologies. Since TWI wanted to expand the understanding of the science behind the process, they decided to involve academics that could work in this relatively unknown area.

Another indicator of TWI encouraging academic involvement is apparent when it comes to license agreements.

The process is protected by an International license held by TWI. You therefore are not allowed to use the process without subscribing to the license agreement. (Danie Hattingh, e-mail, 18 August 2004)

The research license normally costs \pm £28 000 per annum, but when Dr Hattingh approached TWI via Mr John Kell, one of their technical managers, it was decided that PET would not need to pay this fee since the process was not licensed in South Africa.

Motivation for the research

Dr Hattingh was motivated to do research on FSW because this was still a new field of research and therefore the scope would be quite great. Another reason was that South Africa is considered one of the countries that largely produce aluminium and, since this process works best with aluminium, it was regarded as advantageous to South Africa's

industry. The research was relatively new research and geared towards all potential users, of the Aluminium industry of South Africa:

Well if you look at the process it was a relatively new process, so from an academic point of view the scope for research scopes was enormous with respect to it. The second thing I always keep in mind is application and if you think of SA as being one of the biggest aluminium producers, FSW just makes sense. So it's a good process. (Danie Hattingh, interview, 27 August 2003)

A significant component of the research work of the centre is to develop exchange programmes and collaboration between the Technikon and other local and international institutes with the aim of bringing new technologies to South Africa. The centre also aims to branch out into other fields of new technology, for example, on metal cuttings.

None of them are FSW related at this stage, most of them are around student exchange programmes and then we've also got the automotive components technology station here, which is partly German funded. So we've got a lot of collaboration going on within those fields. It's also to bring new technologies to SA. FSW is one. We don't just want to stay in FSW, we need to look at other technologies, for example, metal cutting, e.g. water jet cutting that is one of the fields we are looking at now. There are one or two places in SA that does it, but again it's a technology that has taken off in Germany big time, but not in SA and the reasons why, I am not sure. (Danie Hattingh, interview, 27 August 2003)

3 Key descriptors of the Friction Stir Welding project

In the very beginning, when the project began in January 2002, the hypothesis of the project was established:

That the research undertaken will lead to the innovative development and improvement of the Friction Stir Weld technology by creating a better understanding of the relationship between process parameters, material characterization and weld integrity for a wide range of weld process parameters through advance on-line monitoring and increase system intelligence. (Danie Hattingh, e-mail)

In other words, the FSW project can be seen as an ongoing research programme or research line with distinct projects that are started and completed, their aim being -to better understanding different aspects of the FSW process. For example, "...the first two projects ran around the design and the control systems, Grant Kruger (Electrical) was responsible for controls and Calvin Blignaut was more for the design of the process – Tool Design, Machine Design and all those things" (Hattingh, interview, 27 August 2003).

This section will describe the FSW project in detail by discussing the overall objectives of the project; the team who are working on the project including the team's size, composition, and their roles and responsibilities within the team; the sources of funding; and project outputs and deliverables including dissemination strategies.

3.1 Project objectives

As discussed under the heading Motivation for the Research, it was determined that the attraction for Dr Hattingh, as the project leader, in investigating the FSW process was that, besides it being a new technology to South Africa, he foresaw that there would be a lot of application for the FSW process in South Africa because a high percentage of South African industry is using aluminium.

At present, Friction Stir Welding has found various applications in a number of areas. Potential applications are spaced shuttle fuel tanks, aluminium decking for car ferries, manufacturing of compound aluminium extrusions and automotive structural components. Most of the applications are aluminium alloys although several facilities have reported experiments on titanium alloys and steels. The process is not yet fully understood and further research is required to optimise this technology.

In the FSW project proposal, as put together by Dr Hattingh, the project goals were:

To determine the influence and effect of Friction Stir Welding (FSW) process control parameters on the microstructure of the thermo-mechanically affected zone, the defect population in the weld nugget, and the fatigue and fracture performance of specific aluminium alloys butt welded by FSW. Studies taken by James et al prove that feed has a definite effect on the fatigue life of FSW aluminium material. A more complete study will be done to investigate the influence of feed and rpm on the intrinsic defects of FSW. (Danie Hattingh, e-mail)

Thus it can be seen that the short-term objective of the project was to understand the FSW process and the long-term project objective was “to roll out the process into South African Industry, because there is a lot of application out there for it”. (Danie Hattingh, interview, 27 August 2003).

3.2 Sources of funding

The sources of funding for the project include grants from DST, the Central Research Committee of the Technikon and NRF. In addition, the United States Army funded a workshop on FSW at the PET in April 2003. According to Dr Hattingh, the reason for this financial support was for the US Army to determine the status of the research on FSW at the different research institutes around the world. No other funding was received from the US Army since

...their biggest interest is in the welding of titanium and I think had we the capability of doing FSW with titanium they would have given us more funding, but our machine does not lend itself to welding of titanium sheets. Obviously their interests are aerospace that's why they are moving in that direction. (Danie Hattingh, interview, 27 August 2003).

3.3 Project outputs and deliverables

The main outputs of the project included technical publications papers and patents. One patent is for a retractable tool pin and the other is the Force Food Print (FFP):

There are a number of papers that went out, technical publications papers, there were experiments at the ESRF, international collaboration, funding from the US army air force and now we are busy with a patent on a special tool that we have developed. If I look at what we have done here – the two main outputs – taking all academic outputs away, one is the patent that we are going to have on a retractable tool pin and the second one is the FFP. German research has already latched on to the idea of the FFP, but it is not something you can patent, it is our scientific contribution that will assist with the understanding of the process. (Danie Hattingh, interview, 27 August 2003)

Another output of this project was in the form of student development. Two students, one a mechanical engineering student and the other an electrical engineering student, received their Master's degrees under the FSW project. The tacit knowledge of the researchers is transferred through consultation with industry and the training of students.

3.4 Dissemination strategies

The dissemination strategies of the FSW team have been directed at South African companies, especially those in and around the Eastern Cape. The aim is to get them to use this new FSW process instead of the conventional joining techniques that they are using. At first it was hoped that the Aluminium Federation of South Africa would become a channel for disseminating technology to the rest of the aluminium users of South Africa. This is happening very slowly, because - as stated by Dr Hattingh: "(the) end user in SA is not that susceptible to new technology as in Europe and USA".

Another reason for this slow uptake is because "the rather large license fee imposed currently from TWI is preventing the process from getting commercialised quicker in South Africa" (Danie Hattingh, e-mail, 18 August 2004). Thus Dr Hattingh and his team decided that they would take the initiative and disseminate within South Africa themselves. It seems as though the first step is to make South African industry aware of the advantages of the FSW technique, thereafter the problem with the license would be addressed.

They are inviting companies to the MTRC to give them demonstrations on how the Friction Stir weld is made. They also ask the specific companies, to send their components, on which they are doing their conventional process, to the MTRC and allow the FSW team to weld those components for them. In this way, they can evaluate the weld and the process for themselves:

[] a number of companies who manufacture tank containers - these big ones - they can use the process. We've been in contact with the Aluminium Federation of South Africa, with ESKOM's research group that known as Technology Services International (TSI), there are some possibilities around that and a number of other small companies, we've also been in contact with a ship building company in Durban they are very keen, we've given all

of then samples, we're just waiting for them to come back to us now to take the process forward. (Danie Hattingh, interview, 27 August 2003)

The approach that Dr Hattingh and his team will use to disseminate their research is to write popular articles for magazines such as **SA Mechanical Engineer**. Most importantly, since the team has become experts on this FSW technology and are in a position to be consulted on the process, they will physically go to the specific companies to make a short presentation on the FSW process. They will also take a few samples of FS Welds that were made by the team:

*So the strategy that we will follow now for 2004, because it is too late now, you don't roll out something at the end of the year, people want to get their stuff finished, is we will write popular articles for the **SA Mechanical Engineer**, for those type of magazines, but we will also go on a road show in the sense of physically going to companies with a short presentation and samples of what we can do. The reason why we only can do it now is because we've only really built our expertise to the point now where we feel comfortable to saying yes we can advise people on the process and how to use it. We'll make it on appointment basis and we'll tackle the industry around Richard's Bay which is aluminium driven. Maybe tackle a group of companies in Johannesburg and Cape Town. You just need one guy to take on a process so we only really looking for that one guy because we cannot become a facility that does the welds for industry we're just not geared up for that. (Danie Hattingh, interview, 27 August 2003)*

They hope that after introducing the process, it will be taken up by at least one company who will invest in an industrial facility for which the FSW team will design, develop and build a FSW machine locally. This kind of investment is especially crucial to have the process disseminated, as the MTRC and PE Technikon do not have the necessary funds.

3.5 Positives

There were two positives about this research on FSW. One positive arose out of a negative – lack of access to information. The other positive concerned the fact that the research involved a manufacturing process that fitted well into the already existing expertise of the MTRC. These are discussed in greater detail.

Lack of access to information

Because the only method of obtaining access to the research data of TWI was by being an industrial member and since this entailed an exceptionally high fee that Dr Hattingh and his research team could not afford, they did not have access to this data. However, the positive side to this dilemma was that this led them to become innovative:

we might have reinvented a number of things, but there is a positive to that because that is what has given us a lot of recognition currently because everything we do, we do differently to the rest of the world and that came out in data early this year when we presented a paper (Danie Hattingh, interview, 27 August 2003).

Existing expertise

The research portfolio of the Centre has always been in manufacturing processes with its two divisions of research being in materials research, and electronics and intelligent research. This project gave the MTRC the opportunity to use these two existing fields of research in one project. This was a possible reason why it took a short period for the team to produce the good research result:

Well the research portfolio has always been in manufacturing processes and we've always had two divisions. I was on materials side leading material side research and Theo was leading the electronics and intelligent control research and this project really gave us the opportunity to now put those two fields of expertise into one project because it is a manufacturing process that needed control. (Danie Hattingh, interview, 27 August 2003)

4 The knowledge production environment and process

4.1 Research category of the project

As identified in section 1.2 this research can be categorised as applied research and as being centred on finding answers to questions within existing research. It is also seen as being new technology and the project can be termed as multidisciplinary since it involves electrical and mechanical engineering and is starting to involve industrial engineering and Information Technology.

4.2 Research problems

The problems highlighted by Dr Hattingh concerned equipment, access to information, manpower and research time, but it can be seen that the root cause of these problems are lack of finances.

Access to information

As already stated under the heading Lack of Access to information, Dr Hattingh and his team were not able to access TWI's latest research data. Initially this did not hinder the FSW team since their approach to the research question was and still is completely different to the approach of the rest of the world. However, Dr Hattingh and his team are experiencing that lack of access to information as a problem because they have reached a stage in their research where they would like to see what the rest of the world is doing.

Human resources

Dr Hattingh reported that they have experienced problems in recruiting post-graduate students who have the intellectual ability to be successful in both the practical and analytical side of research. Dr Hattingh states that students who do not do well on the analytical side become a burden to a certain extent. Another problem is that since there are not a lot of researchers working on the project, there is a small research group and thus getting results occurs much slower than at a research centre that has much larger research teams working on FSW, such as at the Research Centre in Geesthacht (GKSS), which is one of the fifteen national facilities that belong to the Hermann von Helmholtz Society of German Research Centres (HGF).

Equipment

Lack of funding led to the equipment or machine that the team developed or could buy being limited or being of a bottom range. This in turn has led to limited research that could be done on the machine. A constant battle has resulted between the team and their funding bodies in their attempt to buy a higher range machine to produce higher quality research.

Research time

Due to the heavy workload of the lecturers at the technicians research time is limited:

GKSS is now threatening to become more of an authority on the FFP principle than what we are... because we are limited to move faster (by) with lack of students, time and funding... Those guys probably put 25 people on that problem of really looking at how to use the FFP to its full potential. We have four guys with two of us doing research as a hobby. So we cannot compete against those people and all that you can hope for is that they will give you the relevant recognition. (Danie Hattingh, interview, 27 August 2003)

4.3 Nature of research collaboration

With the FSW project, the research collaboration exists between certain researchers at the following institutions: PE Technikon, Plymouth University and TWI. Prof James is the link between the TWI and FSW team. Prof James assists the FSW team by informing them of the type of experiments on which the team should concentrate. He determines this by keeping an eye on where the areas in the international world are that need better understanding of the science behind the process.

It is important to note that the collaboration is not between the institutions themselves, but between the researchers of the institutions. It is more of a personal, one-on-one interaction, established through bi-annual visits they each make to each other's institutions, email and telephonic communication, and meetings at other research institutes in Europe, for example in Grenoble, France:

It's personal interaction, one-on-one. I spend time with him in his office, he'll be spending time with me, he's actually coming again in November, the end of November. I've just been there four weeks ago and towards the beginning of this year, April, he was here with the FSW workshop. So we have regular contact and in October I'll be going to Grenoble France again. So we'll meet there again. (Danie Hattingh, interview, 27 August 2003)

Both the Dean of the Faculty Engineering and the Director of the URD have also made similar statements on this topic:

Yes, you network, you get peoples addresses and you get friends and you build up a network. (Theo van Niekerk, interview, 27 August 2003)

We've seen that there can never be agreements on an institutional basis on the final analysis. It's between two individuals that understand one another, trust one another, respect one another's research knowledge and that's what we try and do. (Pieter van Breda, interview, 27 August 2003)

4.4 Interactions with users

TWI can use the research results of the FSW team at to evaluate their current processes and from that they can make the necessary adjustments. The interaction with the users is mainly through Prof James: "initially everything we know about FSW came from TWI, but TWI supported Prof James' research program and I slotted in with Prof James, so that is where the link is, the link is through Prof James and the data we generated". The reason for this is explained by the following: "In the UK it is difficult for me as a South African to make direct contact with them because we don't run our process under a license so we have to go through Neil (Prof James) to a certain extent, but indirectly we are in contact with the users".

No other interaction with users exists, but as mentioned elsewhere, Dr Hattingh and his team are in the process of establishing interaction with potential users in South Africa.

In answer to the question about whether the FSW team approached the two motor manufacturing plants in PE with this FSW process, Dr Hattingh answered that the "...biggest competitor at this stage in the automotive sector for FSW is laser welding - there's a lot of benefits to laser welding". For this reason, no further attempt has been made by the FSW team to have the FSW implemented at these two motor plants. As already stated, the team is rather concentrating their efforts on taking this technology to the aluminium industry.

4.5 Linkage mechanisms

Some local links started at the international workshop held at PET in April 2003. Since the FSW process is much simpler than existing welding processes of aluminium, the Aluminium Federation of SA is playing a big role in alerting industry to this process since they have a vested interest in industry using aluminium:

At this stage it started with the International Workshop that we had a lot of the things started automatically. The Aluminium Federation of South Africa has been quite active in bringing people here because there is a benefit to all aluminium uses because the process is a lot simpler. (Danie Hattingh, interview, 27 August 2003)

Other international links are with TWI, Mr Tony Reynolds at the University of South Carolina and the US Army Air Force Navy Research Office in London.

5 Mode of knowledge utilisation

5.1 The intended users

The users who have been targeted by Dr Hattingh as potential users are companies that could use the process itself, for example Technology Services International, Eskom's research group, The Aluminium Federation of SA and a ship building company in Durban.

5.2 Utilisation strategies

As mentioned under Dissemination Strategies, the procedure that Dr Hattingh and his team are using to get the process out to industry is by inviting different companies to the MTRC to view how the FSW is done and then to give them samples of the weld to take back to their companies. The other strategy Dr Hattingh intends using is taking the FSW process on a “road show”.

5.3 Examples of utilisation

The following quote indicates the current use of FSW process internationally and the more general use of the FSW team’s research results:

The main use of FSW process, at the current moment, is by shipbuilders particularly the ‘Fast Ferry’ fabricators. They are not specifically using our research results. We contribute internationally through publishing our research data in reputable international journals, from where it gets disseminated in to the international FSW community...TWI is aware of our efforts and through Prof James’ involvement we are receiving a lot of international exposure. (Danie Hattingh, e-mail, 18 August 2004)

5.4 Matters of intellectual property and license agreements

As mentioned under Project history, Dr Hattingh had approached TWI to negotiate doing research on FSW without purchasing the license agreement. At the start of the project, there were no intellectual property agreements in place since the process belonged to TWI and since the research Dr Hattingh and his team were doing revolved around developing a better understanding of the process. Also, there is no need for such agreements since a lot of information can be viewed around the process.

We did not have any intellectual property agreements in place with any of our partners because we were really developing a bit of understanding a of new knowledge around the process [] with the process you can see a lot of information around the process, so there is no need really to protect that. (Danie Hattingh, interview, 27 August 2003)

Dr Hattingh also pointed out that “Any ‘new’ Intellectual Property not protected by the original TWI license can be protected by us” (Danie Hattingh, e-mail, 18 August 2004).

Dr Hattingh is also of the opinion that this process should not be kept to the MTRC or kept secret, as it is a process that can benefit industry “this research is there to really benefit the manufacturing industry out there and not for us to keep secret or make money out of it”. (Danie Hattingh, interview, 27 August 2003)

6 Concluding observations: Lessons learnt from this case

6.1 Research transformation

From both the organisational history and project description of this case study it can be seen how over the years a change has occurred within Science and Technology Research in South Africa.

Firstly, the PET evolved from an art school to a tertiary educational institution that provides training to meet the demands of both industry and the market place. Part of the cause of this evolution was the shifting of the research focus, within South African academic institutions, instigated by the government and carried out by the main academic research funding agency in South Africa, the NRF, through the Technikon Research Development Programme (TRDP) and the University Research Development Programme (URDP):

The introduction of new frameworks for the Technikon Research Development Programme (TRDP) and the University Research Development Programme (URDP) in 2001 resulted in the declaration of 2002 as an interim year for the appraisal of Research Niche Areas (RNAs) submitted to the NRF for possible support within these programmes. RNAs that were judged meritorious were provisionally approved, through a shortened approval process, pending the submission of five-year business plans/frameworks for evaluation in April 2002. (<http://www.nrf.ac.za/>).

As early as 1996 PET had already had the foresight to initiate a change such as the above-mentioned. This occurred when Dr Pieter van Breda, the present Director of the PET URDP conducted an audit to determine what was the research focus of each academic department at PET and from there, the number of focus areas per faculty were reduced:

When I came to the Technikon, seven years ago, we really didn't have these six NRF Research Niche Areas. We had what I would call pockets of research expertise and one of the first things I did was to produce a research report for that was a crucial internal document, because what happened was I forced - for the first time - academic departments to indicate to me what are their research focus areas within that department. Some departments with five or six staff members originally indicated that they have ten research areas and I said: "It can't be!" So we eventually, within the URD, then decided on one or two areas per department. So that was the first part and then when we went through that exercise, the research report very clearly showed where the outputs, firstly, where the strengths would be in terms of qualifications [] The research report was the first audit of research capacity at the institution. (Pieter van Breda, interview, 27 August 2003)

Then later in 1998, PET again displayed insight with the transformation of the engineering faculty to that of the MTRC.

6.2 Government–industry–academic relationships

This type of relationship, networks that exist between academic research institutions, industry and the government serves to encourage the production and utilisation of research and knowledge. This relationship also creates the opportunity for industry to have a greater say in the research that is undertaken at the academic institution. An indication of such a relationship is shown in the project description when we see how research that occurs in academia strives more and more to involve industry in its activities and to direct this research to being more relevant and useful to both industry and the country.

6.3 International co-operation.

This case study clearly illustrates that the importance of academic research institutions having international links was not lost by government, specifically DACST, and by the PET. With the PET, a link was formed between the MTRC and the German Universities of Applied Science. With DST, a link was formed with the German Agency for Technical Cooperation (GTZ).

Another important point to note, as highlighted by this case study, regarding the international partner that PET considers as a candidate is explained by the following statement made by Dr Van Breda:

If Volkswagen South Africa runs into problems on their production line they will not come to a local institution, any university or technikon in South Africa (for assistance). They will go back to Germany where they have their traditional industrial partner who solves problems for them, if they can't solve it themselves. So the jackpot is to see the industrial partner of Volkswagen in Germany, who is their academic link, and then through that academic side get into the picture. That's been our strategy all along. (Pieter van Breda, interview, 27 August 2003)

6.4 Communicating research

From the section on the Nature of Research Collaboration it is obvious that the Manager of ACTS, the Dean of the Faculty of Engineering and the Director of the URD at PET all agree that it seems that one-on-one communication within organisations or institutions is important for technology transfer to occur whether the transfer happens between users and producers or between two research groups.

6.5 Dissemination

Solely relying on publications to get one's results disseminated to the target group is not sufficient. The researchers themselves have to go out and "sell" their research. Dr Hattingh illustrates this with the realisation that to get the South African industry to take up the research results of the FSW process, he would have to go on a "road show".

6.6 Research isolation

It would seem that doing research in isolation from the rest of the world has its pros. In this case, because the researchers were left to their own devices, it led to them using very unique ways of producing results.

6.7 Technology stations

These stations, housed at academic institutions, are similar in their roles to "academic incubators" and "science parks". Within such a context or organisation, besides the greater probability of transfer of knowledge from research institution to industry being increased and being immediate, what is also ensured is that the research institution does research that will be utilised by industry.

6.8 Slow research uptake by industry

Contrary to the former point is the fact that the Dr Hattingh, as the project leader, has experienced the South African industry to be slower in taking up new technology than Europe and the USA. For this reason the South African researchers, have to carry out the dissemination strategies as already mentioned.

6.9 Research in the interest of national goals

From this case study it is evident that over the past ten years there have been many governmental developments, which through the aid of funding organisations such as the NRF, have caused dramatic shifts in the research agendas of academic institutions like PET and these changes have ultimately manifested themselves in research projects such as the FSW project.

Data sources

Face-to-face interviews

Dr Danie Hattingh (Technology Manager: Automotive Component Technology Station at Port Elizabeth Technikon), 27 August 2003.

Dr Pieter van Breda (Director: Unit for Research Development at Port Elizabeth Technikon), 27 August 2003.

Prof Theo van Niekerk interview (Dean: Faculty of Electrical and Mechanical Engineering at Port Elizabeth Technikon) 27 August 2003.

E-mail responses to additional questions

Dr Danie Hattingh, 25 March 2004

Dr Danie Hattingh, 18 August 2004

Prof Theo van Niekerk, 25 August 2004

Questionnaire

'Public sector R&D in South Africa: The production and utilisation of research' questionnaire completed by Dr Danie Hattingh, October 2002

Publications and documents

ACTS Annual Report compiled for Tshumisano (2002)

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DTI (2003a) *Accelerating Growth and Development: The Contribution of an Integrated Manufacturing Strategy*. Pretoria: Department of Trade & Industry

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Port Elizabeth Technikon Research Report (1999) Unit for Research Development, Port Elizabeth Technikon

Websites visited

<http://www.petech.ac.za/>

<http://www.twi.co.uk/>

<http://www.fsw.petech.ac.za/>

Appendix: Career profiles of FSW team members

Dr Danie Hattingh started out his career as a research and development engineer for five years (1984 - 1989) in a leading international fan manufacturing company. In 1989 he started as a lecturer in the mechanical engineering discipline at PE Technikon, he was promoted to senior lecturer in 1992 where his main responsibility was the managing of the Department Applied Engineering Management and in 1996 he was promoted to Head of Department of the Department of Mechanical Engineering. During 1998 he took over the management of the Department of Materials and Metallurgical Engineering with the responsibility to incorporate it into the Department of Mechanical Engineering. Currently he is the Technology Manager of ACTS while still acting as supervisor to a number of post-graduate students. The area of research in which he has specialised is Manufacturing Technology and Materials. This involves the enhancement of product quality through creating a better understanding of material behaviour during manufacturing processes and is an important method for optimising design and manufacturing processes. Expertise developed by him is now used by the ESRF in Grenoble France to assist with the analysis of residual stresses using synchrotron radiation. The MTRC has completed a number of projects that contributed to enhance products through modelling the relation between manufacturing parameters and material properties such as fatigue life and residual stresses. Dr Hattingh's research achievements include being an L - Rated researcher and a grant holder with the NRF and receiving the "New Researcher of the Year" award in November 1998 and the "Researcher of the Year" award in March 2002 from Port Elizabeth Technikon. He was also elected as a full member of an International Research team to do experiments at the ESRF. Currently Dr Hattingh is involved in consulting work for industry in the field of materials, material testing and failure investigations and has been doing such consultancy work since 1989.

Prof Theo van Niekerk started as a lecturer at Port Elizabeth Technikon in 1990 and has since progressed to become the dean of the Faculty of Electrical and Mechanical Engineering at the same Technikon. In his years at PET, he developed and introduced a number of high-level hardware and software development upgrade courses, that enabled practising Engineers, Technologist and Technicians to obtain first hand experience of the rapidly changing engineering environment. He is an established researcher and NRF grant holder (since 1992) within the multi-disciplinary MTRC and provides leadership and expertise for research and development within the areas of Industrial Process Monitoring; Diagnosis and Control for Automation, Manufacturing process development, evaluation and optimisation for discrete part manufacturing and Mechatronic System Development / Robotic Applications. Prof van Niekerk was also able to access crucial external funding, in excess of R500 000, to contribute to establishing a research infrastructure within the MTRC.

Mr Grant Kruger first started his career during high school by running a part-time computer dealership from home and since then his interests have always been in electronics and electrical engineering. Occasionally during high school he also did an apprenticeship at PE Technikon's Technical Services and now and then he works as a Technical Assistant for a company called Computers, Satellites and Electronics (CSE). In 1999 he had a six-month contract as a Technician for SABC and since 2000 he has been working as a research assistant at the MTRC. He is currently enrolled for a DTech, Electrical Engineering at PET (CV of Mr G Kruger).

Mr Calvin Blignaut's professional background, up to date mostly includes academic related work in the R & D sector covering various fields of practice in Mechanical Engineering. In 2000 he did his in-service-training as a technician at Continental Tyres in SA, in 2001 he worked as an assistant researcher in the Faculty of Electrical and Mechanical Engineering and since 2002 he has worked as a Researcher specialising in FSW at PET. He is currently enrolled for a DTech, Mechanical Engineering at PET (CV of Mr C Blignaut).

CASE STUDY 5

RUNNING A COLLABORATIVE RESEARCH PROJECT AS A SHAREHOLDING COMPANY

The case of African Medical Imaging (Pty) Ltd in South Africa

An Innovation Fund-supported project, led by Prof Kit Vaughan, Director of the MRC/UCT Medical Imaging Research Unit at the Department of Human Biology, University of Cape Town

by Nelius Boshoff



Lodox machine in the Anatomy Building at the Medical Faculty of the University of Cape Town. Photography provided by Prof Kit Vaughan.

CONTENTS

Abbreviations	206
1 Introduction	207
2 The broader organisational context	207
2.1 Medical imaging expertise at the University of Cape Town	207
Biomedical Engineering at the Department of Human Biology	208
Medical Imaging Research Unit	208
2.2 De Beers and Debex Pty Ltd	209
2.3 Medical Radiation Group at iThemba LABS	209
2.4 The project leader	209
2.5 The Innovation Fund	210
3 Project background	211
3.1 Project history	211
Events that preceded African Medical Imaging (AMI)	211
AMI as a commercial vehicle for a project	213
3.2 Project objectives	215
3.3 Project funding	215
3.4 Project team members	215
3.5 Project outputs	216
3.6 Project location within regulatory and socio- economic realities	216
4 Mode of knowledge production	217
4.1 Nature of the research performed	217
Lodox-MP	217
Lodox-CT	218
Lodox-TB	219
4.2 AMI's internal and external relationships	220
AMI and UCT	220
AMI and De Beers	223
AMI and iThemba LABS	224
AMI and MIRU	225
5 Mode of knowledge utilisation	226
5.1 The commercialisation of AMI's intellectual property	226
Lodox Systems and its relation to AMI and UCT	227
The perceived value of AMI's intellectual property and contribution to Lodox Systems	228
AMI's liability to the IF as a complicating factor	231
5.2 Clinical research utilisation	231

6	Insights derived from this case	232
	Data sources	239
	Face-to-face interviews	239
	Telephonic interviews	239
	E-mail response to additional questions	239
	Publications and documents	239
	Websites visited	240
	Appendix 1: Project outputs	241
	Journal articles	241
	Book chapter	241
	Conference papers	241
	Internal report	242
	Postgraduate theses	242
	Other	243
	Appendix 2: The different organisational structures and their relation to AMI	244

Abbreviations

AMI	African Medical Imaging
CAD	Computer-aided diagnosis
CT	Computed tomography
DBCM	De Beers Consolidated Mines
DST	Department of Science and Technology
IDC	Industrial Development Corporation of South Africa
MIRU	Medical Imaging Research Unit
MP	Medical prototype
MRC	Medical Research Council
NAC	National Accelerator Centre
NRF	National Research Foundation
OIL	Office for Industrial Liaison
R&D	Research and development
SPII	Support Programme for Industrial Innovation
TB	Tuberculosis
UCT	University of Cape Town
USPTO	United States Patent and Trademark Office
WIPO	World Intellectual Property Organisation

1 Introduction

Biomedical engineering is an interdisciplinary field, which is concerned with the application of engineering principles (electrical, chemical, mechanical or other) to biological and medical issues. The integration of aspects of the engineering and life sciences generally occurs with three broad outcomes in mind (HUB 2003):

- ◁ To understand, modify or control biological systems (bioengineering)
- ◁ To design and manufacture products that can monitor physiological functions and assist in the diagnosis and treatment of patients (medical device engineering), and
- ◁ To maintain and manage the complex mix of technology typically found in hospitals and clinics (clinical engineering).

The focus of this case study is on a collaborative research project that falls within the area of medical device engineering – more specifically, within the sub-area of medical imaging. Medical imaging is concerned with the visualisation of the interior of the human body. A classic example is X-raying, which also constitutes the focus of the collaborative project.

The project can be summarised as follows: De Beers, the leading diamond industry in South Africa, had developed an ultra-low dose X-ray system (called Lodox) with a specific application to trauma. Together with a group of researchers from the University of Cape Town (UCT), representing various disciplines, a research consortium was formed. The consortium also included a research facility of the National Research Foundation (NRF). Under the leadership of Prof Kit Vaughan from the Department of Human Biology at UCT, a grant application was made to the Innovation Fund of the Department of Science and Technology (DST). The grant was approved and the consortium organised itself into a commercial company, known as African Medical Imaging Pty Ltd (AMI). De Beers, UCT and NRF were allocated company shares to prevent future disputes about the distribution of intellectual property ownership.

The question to be answered through this case study is: to what extent does the particular mode of knowledge production (i.e. the shareholding company route) enable or constrain effective commercialisation? Before doing so, the broader organisational context of the project is discussed.

2 The broader organisational context

2.1 Medical imaging expertise at the University of Cape Town

The academic expertise in medical imaging in South Africa is located at UCT. An innovation hub has developed around Prof Kit Vaughan and his team of collaborators, which involves academic staff and postgraduate students from various departments (such as Human Biology, Electrical Engineering, Radiology and Computer Science). Prof Vaughan is the head of the division of Biomedical Engineering at the Department of Human Biology, as well as the director of a collaborative unit of the Medical Research Council (MRC) and UCT. Each of these will be discussed separately.

Biomedical Engineering at the Department of Human Biology

The Biomedical Engineering division is one of four academic groups within the Department of Human Biology. The other groups are Anatomy, Exercise Science and Physiology. Prof Sue Kidson heads the department. The department's history goes back to 1969 when a Department of Medical Physics and Bioengineering was established at UCT. After splitting in 1972, the one leg, the Department of Bioengineering, eventually became the Department of Biomedical Engineering. It is within this department that Prof Vaughan was appointed as Hyman Goldberg¹ Professor in 1996. Four years later, in 2000, the Department of Biomedical Engineering merged with two other departments (Anatomy and Physiology) to form the Department of Human Biology. Prof Vaughan headed the new department for three years until Prof Kidson took over (HUB 2003). Specifically with regard to Biomedical Engineering, the department offers an MSc (Med) in Biomedical Engineering, which consists of coursework and a thesis.

The functions of the division of Biomedical Engineering, and its outreach, can be summarised as follows:

The functions of Biomedical Engineering are to teach and conduct research within the university context and to provide a service to the hospital [Groote Schuur] as well as the broader community, both nationally and regionally [] Members of the department publish articles in scientific journals and deliver papers and scientific lectures locally, nationally and internationally. Popular articles are contributed to magazines and newspapers and members of staff occasionally appear on television and radio. The members of the department also participate in the activities of various university, hospital, community, national and international committees and organisations. (HUB 2003)

The Biomedical Engineering division is subdivided into seven groups: Biomechanics, Health Informatics, Healthcare Technology Management, Medical Imaging, Physiological Flow Studies, Rehabilitation Engineering, and Signal Processing in Electro-encephalography (EEG). Prof Vaughan is the leader of two of these subgroups (Biomechanics, and Medical Imaging). The Medical Imaging group, within which AMI is located, is run as a MRC/UCT Research Unit – the Medical Imaging Research Unit.

Medical Imaging Research Unit

The Medical Imaging Research Unit (MIRU) officially opened on 11 May 2000, under the directorship of Prof Vaughan. It is a joint unit of the MRC and UCT². The mission of MIRU is:

[] to conduct world-class research in medical imaging that specifically addresses the health care needs of Africa. Our research focuses on the role of medical imaging in health care problems such as trauma, cancer, tuberculosis (TB), neuromuscular disorders, cardio-vascular

¹ Dr Hyman Goldberg made a donation for a Chair of Biomedical Engineering in 1982.

² A MRC unit at an academic institution "is established under the leadership of a director, who must enjoy national and international recognition. A well-qualified and productive research team and necessary infrastructure must already exist. Focused research to be conducted must be important for health science in general and the needs of the country. A unit is funded in 5-year cycles with an anticipated life span of 15 years." (<http://www.mrc.ac.za/>)

disease, and alcohol abuse. MIRU has a multidisciplinary focus, attracting talented physicists, engineers, computer scientists and medical doctors. (MRC 2002:2)

Six staff members, including Prof Vaughan, constitute the core of MIRU.

2.2 De Beers and Debex Pty Ltd

De Beers is the world's largest diamond miner and marketer. De Beers Consolidated Mines Limited (DBCM) controls its South African interests. During the course of the project, the R&D arm of De Beers was known as DebTech. DebTech was closely related to Debex, a company that commercialises the products of DebTech. The focus of Debex was on the development and manufacture of low dose X-ray systems for detecting and sorting diamonds. Both DebTech and Debex were wholly owned subsidiaries of De Beers, and shared the same management. Mr Herman Potgieter was the manager of the Lodox division of Debex at the time of the project start. He occupied this position until 2001.

2.3 Medical Radiation Group at iThemba LABS

iThemba LABS (LABS = Laboratory for Accelerator Based Sciences) is a multidisciplinary research facility administered by the National Research Foundation. It provides facilities for

- (a) basic and applied research using particle beams,
- (b) particle radiotherapy for the treatment of cancer,
- (c) the supply of accelerator-produced radioactive isotopes, and
- (d) nuclear medicine and research (www.tlabs.co.za). Prof Vaughan's collaboration with iThemba LABS was with the Medical Radiation Group, of which Dr Dan Jones is the director.

The group's activities can be summarised as follows:

The Medical Radiation Group operates the hadron (neutron and proton) therapy facilities at iThemba LABS. Hadrons are nuclear particles used in the treatment of cancer and other diseases. It is the only hadron therapy centre in Africa and in the Southern Hemisphere. It is also the only centre in the world where patients can be treated with both high-energy neutrons and high-energy protons. Patients from all over South Africa as well from neighbouring countries have been treated on the facilities. The Medical Radiation Group also provides unique opportunities for research and actively supports the training of apprentices, technikon students and post-graduate university students. (<http://www.tlabs.ac.za/public/MedicalRadiation.htm>)

When the Innovation Fund project started, iThemba LABS was still known as the National Accelerator Centre (NAC).

2.4 The project leader

Prof Vaughan studied at Rhodes University in South Africa, where he in 1975, completed a BSc Honours in Applied Mathematics and Physics. He subsequently studied at the

University of Iowa in the United States, obtaining a PhD in Skeletal Biomechanics in 1980. Between 1980 and 1986 he lectured at UCT. In 1986 he moved abroad where he held various positions at universities – his latest was as Director of Motion Analysis Laboratory at the University of Virginia in the USA. He returned to South Africa in 1996 to take up the Hyman Goldberg Chair in Biomedical Engineering at UCT. In 2002 he was selected for an ETS Walton Visitor Award by Science Foundation Ireland. As a result, he spent a twelve-month sabbatical in Ireland in 2003, at University College Dublin.

Prof Vaughan has 20 years of experience within the industry sector. For instance, he acted as an Engineer Designer and Management Consultant with Becton Dickinson – a large medical device company in the USA. This resulted from an innovative wrist brace that he designed in the mid-90s to treat carpal tunnel syndrome, which was patented in the USA. Before that, in the mid-80s he designed software for a digital camera system.

In early 2004 he received an A-rating with the NRF, the most prestigious rating for any researcher in the country. This confirmed his status as a leading international scholar in biomedical engineering. Between 2000 and 2001 he was also President of the International Society of Biomechanics, and is currently the Associate Editor for two engineering journals.

Despite all these achievements, he sees the training of postgraduate students as his greatest achievement.

I got my PhD twenty years ago and if I look back on the last twenty years and I sort of peruse my CV or I look up at my library here in my office, the thing that gives me the most satisfaction is the postgraduate students whom I trained. In other words, those who had done Masters and PhD and post-Doctoral fellowships with me. And I think that is the most important thing - making a difference to people and people's lives. (Kit Vaughan, interview, 6 February 2001)

2.5 The Innovation Fund

The Innovation Fund (IF) was officially launched in March 1998. It is a major funding initiative of the South African White Paper on S&T, established to support large-scale, long-term, innovative and collaborative projects in the higher education sector, government SETIs (i.e. science, engineering and technology institutions), civil society and the private sector. Its principal objectives, at establishment, were:

- ◀ To permit a reallocation of resources from the historical patterns of government science towards the key issues of competitiveness, quality of life, environmental sustainability and harnessing information technology
- ◀ To increase the extent to which funds for the activities of government SETIs are obtained via competitive processes, and
- ◀ To promote increased networking and cross-sectoral collaboration within South Africa's national system of innovation (DACST 1996:25).

Funds are accessed through a process of competitive bidding and, in the case of a successful grant application, the IF expects a return on its investment:

The Innovation Fund has a 'high investment, high expectation' approach – it expects a return on investment once a project embarks on the commercialization route. Due to the high cost of investment, each project is scrutinized for its novelty, technical and financial soundness. If the right balance between science and commercialization is achieved, a project gets the go-ahead. Once a project is commercialized, the fund implements a 5% levy on income delivered from the exploitation of intellectual property rights or other suitable revenue streams. (NRF 2002:11)

Prof Vaughan and his team were funded within the 'New Materials and Advanced Manufacturing' focus area (Proposal 32261). The focus of their successful grant application was on the application of low dose digital X-rays to primary health care. The low dose digital X-raying technology originated with De Beers, prior to the establishment of AMI.

3 Project background

3.1 Project history

Events that preceded African Medical Imaging (AMI)

In October 1991 the De Beers Board funded the development of an ultra low dose full body X-ray machine, called Scannex. This emanated from a technical concept of low dose X-radiation, which a group of De Beers researchers had developed earlier on, to be used in the scanning of employees without exposing them to potentially harmful X-rays. The reason for De Beers' scanning of employees was to detect concealed diamonds. An application was successfully filed with the US Patent Office (in November 1993) and patent number 5,404,387 was granted (IF 1999:39). According to the patent abstract:

The invention concerns a method and apparatus for scanning bodies, typically human bodies [] for security or medical purposes. In the method, the body [] is scanned with a beam [] of X-radiation of sufficiently low intensity that no physiological damage is suffered. The X-radiation transmitted by the body [] is then converted into an optical image. The optical image is intensified and converted into an electronic image. The electronic image is manipulated to produce a scanned image of the body or a portion of the body. The scanned image is typically a video image. (<http://www.uspto.gov/>)

Scannex was completed in 1995 and demonstrated to a group of medical experts. Trauma was identified as one medical application that could benefit from whole body scanning. Subsequently, in July 1995, the De Beers Board gave the green light for another prototype to be built. This prototype, called Scannex II, was commissioned to the Trauma Unit at Groote Schuur Hospital in Cape Town. Here it was evaluated in terms of ergonomics, clinical performance and radiation safety and a requirement specification for trauma application was formulated. Once convinced that the requirement specification could be met, in November 1997 the De Beers Board approved the building of an improved prototype, exclusively devoted to trauma (IF 1999:39). The name of the prototype was Lodox-MP. (Lodox is an acronym for low dose X-rays, and the MP stands for 'medical

prototype'.) Debex, a wholly owned subsidiary of De Beers responsible for R&D commercialisation, received R1.5 million from the Support Programme for Industrial Innovation (SPII)³ in 1997/98. This, together with Debex's internal funds, financed the building and commissioning of Lodox-MP. At that stage, Mr Herman Potgieter was the manager of the Lodox division of Debex at De Beers.

In 1998 Prof Gerhard de Jager from the Department of Electrical Engineering at UCT, introduced Prof Vaughan to Mr Potgieter. Prof de Jager, and Prof Steve Beningfield from the Department of Radiology, had been collaborating with Mr Potgieter in the evaluation of Scannex II at Groote Schuur Hospital.

The reason for Prof Vaughan's outreach to De Beers (via Mr Potgieter) was his vision of establishing the Allan Cormack Institute for Medical Imaging, in honour of Prof Cormack⁴, who died that same year (1998). Prof Cormack won the prestigious Nobel Prize in Medicine, in 1979, for pioneering work in the development of the computer tomographic (CT) scanner. Much of Prof Cormack's pioneering work was conducted in South Africa during the 1950s. Prof Vaughan wanted to acknowledge his accomplishments by setting up an African centre of excellence in medical imaging. He saw the mission of the proposed institute as follows:

The mission of the institute will be to conduct world-class research in medical imaging that specifically addresses the health care needs of Africa. The institute will have a multidisciplinary focus, attracting talented physicists, engineers, computer scientists and medical doctors. Not only will it cut across departmental boundaries at UCT, the institute will also facilitate the active collaboration with other universities and organisations in South Africa and abroad. (MRC 1999)

De Beers was an obvious choice for research collaboration, given their innovative approach to whole-body scanning as embodied in the Lodox technology. (Lodox-MP has a radiation dose that is only 5% of standard X-raying). Other potential collaborators were also identified, among which the Medical Radiation Group at iThemba LABS, with whom Prof Vaughan had prior collaboration. Prof Vaughan invited all these groups to a meeting:

In February 1999 I called a meeting of all potential members to help us set up the Allan Cormack Institute for Medical Imaging. These included academic staff from UCT (from the Faculties of Medicine, Science and Engineering), engineers from De Beers, and medical physicists from the National Accelerator Centre (NAC). We needed to raise the necessary operating costs and I suggested that we apply to the Innovation Fund. The deadline was March 1999 and I offered to write the grant. (Kit Vaughan, e-mail)

³ The SPII Programme is funded by the Department of Trade and Industry and administered by the Industrial Development Corporation. It is designed to promote technology development in manufacturing industries in South Africa through support for innovation of competitive products and/or processes (<http://www.spii.co.za/>).

⁴ Prof Cormack was a graduate of UCT and lectured in the Department of Physics from 1950 to 1956. During his teaching years at UCT, he was seconded to the Groote Schuur Hospital where he started a research project that laid the foundation for the development of the CT scanner. From 1957 until his death in May 1998 he worked at Tufts University in Boston, USA.

Thus, in February 1999, the core of the three groups of AMI shareholders (UCT, De Beers and iThemba LABS) came together for the first time. What clearly emerge from the quote above is that the meeting was about establishing a multi-disciplinary research centre and that the decision to work together was made around a grant application to the IF. The rather lengthy application was written in a period of one month (see Sections 3.2 and 4.1 for a discussion of the project objectives and key activities). In September 1999 the consortium was told that the IF application had been approved.

AMI as a commercial vehicle for a project

Prof Vaughan wanted to run the project through the proposed Alan Cormack Institute for Medical Imaging. However, this option was never really tabled.⁵ In fact, the ownership of intellectual property immediately became an issue and it was therefore decided to establish a for-profit company that would own all intellectual property created by the research team.

As Mr Potgieter explains:

We all went into this jointly and we said, ok, this is great. Now that we've got this money, how are we going to [] if something fantastic and incredibly valuable comes out of this, how are we going to decide [] what belongs to the university, what belongs to Debex and what belongs to the National Accelerator Centre [iThemba LABS]. And I actually went and consulted some De Beers' lawyers who recommended I go and see a professional business consulting lawyer, which I then went to see and the only way he could think is that we sit down beforehand and work out who is contributing what and according to that, allocate shareholding in a company. And that was done in conjunction with discussions with some university IP lawyers as well. (Herman Potgieter, interview)

The issue of intellectual property ownership was the single most important reason for establishing AMI. From a financial point of view, the consortium also thought that it would be easier to run the project as a company (with its own financial administration system) rather than relying on the university. Moreover, a legal company requires properly audited books, meaning that spending would be better controlled. At that stage, it was not clear to what extent the IF would exercise project control:

We – certainly myself – didn't have a clue at what level the Innovation Fund was going to apply control, and forming it as a legal company more or less guarantees its appropriate control. (Herman Potgieter, interview)

⁵ The Alan Cormack Institute for Medical Imaging has still not been officially launched.

According to Prof Vaughan, the allocation of shares was decided on a number of principles:

First, De Beers could not hold more than 49% because of their problems with trading in the USA⁶. Second, we looked at what each of the parties (De Beers, UCT, NAC) would be bringing to the consortium, in terms of prior expertise and contribution to overhead expenses. Third, we wanted NAC to have a meaningful equity (i.e. more than one or two percent). Fourth, we wanted to create the mechanism for a share incentive scheme that would allow us to reward AMI employees, and perhaps AMI Directors, for service to the company. That amount was set at 10%, but it was only to be decided upon at a later stage. So, the initial equity split was: De Beers 49%, UCT 44%, and NAC (actually the NRF) 7%. At some later stage, UCT was to give up 8% of its equity and NAC 2% of its equity, to create the 10% share incentive trust, but this never happened.⁷ (Kit Vaughan, e-mail)

AMI has a Board of Directors, consisting of 10 people: 5 from UCT, 4 from De Beers and 1 from iThemba LABS⁸. At the inaugural meeting in March 2000, Mr Potgieter was elected as Chairman of the Board, and Prof Vaughan as Managing Director of AMI. The IF project formally began on 1 March 2000 and came to an end on 28 February 2003. These represent the active years of AMI. The company, however, was listed with the Registrar of Companies already in November 1999, shortly after being informed about the outcome of the IF application. Prof Vaughan reported that the IF, in the person of Ms Marjorie Pyoos of DST⁹, had no reservations about the project being run as a commercial company.

Before getting to the details of AMI, just one point of clarification: AMI should not be seen as a spin-off company. Although it is referred to as a spin-off in the final report to the IF (IF 2003:30), it does not meet the criteria of one. A true spin-off is created with the intention of taking a certain kind of technology (usually non-core technology) out of a parent organisation and commercialising it. It was never the intention with AMI to commercialise De Beers' Lodox technology. The intention was to capitalise on Lodox by developing added-value technology and to market these independently. Suffice to say that AMI should be seen as a hybrid organisation within the changing landscape of R&D production.

⁶ Since 1945 De Beers could not legally and openly trade diamonds in the United States, due to charges of price fixing. It had to operate through intermediaries. In 1994 the company was officially charged, which resulted in a decade-long lawsuit. The lawsuit was officially ended in July 2004, when De Beers pleaded guilty to conspiring to fix prices in the diamond industry. The company paid a fine of \$10 million and, as a result, can now again directly trade in the United States (<http://www.finance24.co.za/>, 14 July 2004).

⁷ Because the share incentive trust never materialised, it is not that far-fetched to argue that UCT and NAC (now iThemba LABS) have 8% and 2% too much shares in AMI.

⁸ Only four of the 10 members of the Board of Directors had signatory powers (Prof Vaughan and Mr Potgieter, as well as Prof Benningfield and Prof De Jager), and approval of two was required for financial transactions. The Board met quarterly, except for 2003 when Prof Vaughan was on sabbatical in Ireland and everything basically came to a standstill.

⁹ Ms Pyoos has been the Chief Director: Research and Technology Transfer at the Department of Science and Technology since 1995.

The following section focuses on the key project descriptives (objectives, outputs etc.), which also are representative of AMI.

3.2 Project objectives

The project is about the application of low dose digital X-rays to primary health care, with a focus on limited angle computed tomography and population screening. There were three overall objectives (IF 1999:5):

- (1) *To complete the successful installation and commissioning of the LODOX-MP system in the trauma unit at Groote Schuur Hospital. This system will then form the test-bed for the next two objectives.*
- (2) *To determine the feasibility of limited angle computed tomography to generate 3D data of structures in the human body. This will necessitate the modification of LODOX-MP [into LODOX-CT] so that it can rapidly and automatically acquire patient data from multiple angles. The major effort will be concentrated on the mathematical algorithms and their computer implementation.*
- (3) *To build LODOX-TB which will be designed for performing high throughput population screening, with special emphasis on tuberculosis. This will require the development of computer algorithms to identify and present important features associated with lung disease.*

These objectives resonate with the focus of AMI, formulated as follows on the AMI website (when the website was still active):

At AMI our focus is on Research and Development in the field of Digital Medical Imaging. We specialize in transforming digital imaging data into useful diagnostic information, as well as devising new applications for existing imaging technology. (<http://www.ami-online.com/>)

3.3 Project funding

AMI received R7.6 million from DST as part of the IF grant. Payment happened in four tranches. The first three tranches were transferred in 2000, via UCT. In 2001, the balance was transferred directly into AMI's account. More than R0.5 million was earned in interest. Close to R0.5 million was also earned through software and hardware engineering services.

3.4 Project team members

According to the final report to the IF, 14 academic and clinical staff from UCT and Groote Schuur participated in the research project, together with four Debex engineers and two medical physicists from iThemba LABS.

The disciplinary affiliations and names of the UCT and Groote Schuur Hospital team members are as follows:

Applied mathematics	Dr Sibusiso Sibisi ¹⁰
Biomedical engineering	Prof Kit Vaughan / Dr Tania Douglas
Computer science	Prof Edwin Blake / Dr Patrick Marais
Electrical engineering	Prof Gerhard de Jager / Dr Tony Heher ¹¹
Medical physics	Dr Egbert Hering / Mr Jan Hough / Ms Elmari Lätti
Radiology	Prof Steve Beningfield / Ms Gillan Bowie
Trauma surgery	Dr Andy Nicol / Mr Bastian van As

The Debex and iThemba LABS researchers were:

Debex Pty Ltd, De Beers	Mr Herman Potgieter / Dr Andre Booysen Mr Carlos Sousa / Mr Paul van Looy
iThemba LABS	Dr Dan Jones / Mr Nick Schreuder

Moreover, 14 UCT postgraduate students worked on the project (12 Masters and 2 Doctoral students). Of these, 4 were women. Only 2 of the 14 students were not South African citizens.

AMI appointed a financial manager, Mr Eserick Watkins, who also acted as the company’s secretary. He reported to Prof Vaughan. A hardware engineer (Mr Jacob Lagendyk) was also appointed, as well as a software engineer (Mr Ben Wright). It was originally intended that both engineers reported to Prof de Jager, although in the end they actually reported to Prof Vaughan. One of the software engineer’s responsibilities was to serve as the gatekeeper for the students’ source code.

3.5 Project outputs

The project, in general, has generated a significant number of outputs (patents, journal articles, conference papers, student dissertations etc.) These are listed in Appendix I according to the category of output. It must be pointed out, though, that some of the output happened independently of AMI funding.

3.6 Project location within regulatory and socio-economic realities

The European community is tightening its regulatory legislation as far as X-raying is concerned: the radiation dose must be kept to the minimum while at the same time the image produced must be of high quality to ensure accurate diagnosis. The South African Department of Health abides by this regulation.

¹⁰ Dr Sibisi was the Deputy Vice-Chancellor for Research and Innovation at UCT, and one of the five university representatives on the AMI Board of Directors. He left the university in 2002 to direct the Council for Scientific and Industrial Research (CSIR).

¹¹ Dr Heher is the Director of the UCT Innovation Office. He replaced Dr Sibisi on the AMI Board of Directors.

It is against this backdrop that the modification of Lodox-MP¹², to include the capacity of computer tomography (i.e. Lodox-CT), needs to be appreciated. Not only would Lodox-CT meet the safety requirement of ultra low X-ray dosages but it would also have the added advantage of producing three-dimensional images, which will assist diagnosis. In addition, the country would profit in an economic sense from the new technology. According to the IF application (IF 1999:17), South Africa did not gain financially from the pioneering work of Prof Cormack. International companies (General Electric in the USA; EMI in Great Britain; Siemens in Germany) profited from Cormack's basic CT algorithms. Prof Vaughan felt that the Lodox-CT component of the project, if successful, could change events. South Africa would finally have an opportunity to gain from work that originated in Cape Town almost 50 years ago.

The population-screening component with the focus on tuberculosis (i.e. Lodox-TB) is firmly located within the South African context. It demonstrates sensitivity for disadvantaged communities, as tuberculosis primarily affects African and Coloured people in the Western Cape. Moreover, the project application argues that a mass screening X-ray system would assist the Department of Health in its strategy of early diagnosis and immediate treatment of TB. The alternative to mass X-ray screening is the sputum test (a form of mycobacteriology testing that is favoured by academic first-world medicine). However, the sputum test has limited practical application in developing countries, like South Africa. The reason is that the test can take up to a few days to determine a person's TB status. This presents a problem, as it is difficult to follow up on rural and township patients once they have left the clinic. Thus, no treatment can be arranged, as the person disappears in the community before his or her status is known. The advantage of mass population screening, through the Lodox system, is that the result is known within minutes (IF 1999: 13).

Thus, through the focus on Lodox-CT and Lodox-TB, the project incorporated both a national economic benefit as well as a benefit to disadvantaged communities.

4 Mode of knowledge production

4.1 Nature of the research performed

Lodox-MP

Lodox-MP, which was commissioned by De Beers in November 1997 (see Section 3.1), was installed at Groote Schuur Hospital during the second half of 1999. The IF project started in March 2000. Hence, the installation of Lodox-MP was almost completed when the project funding began. What remained was a series of clinical trials to assess the performances and qualities of Lodox-MP against those of conventional radiography. The comparative clinical trials¹³ involved the following:

Digital images of a variety of body regions commonly imaged in trauma were compared for diagnostic image quality in a number

¹² It is important to keep in mind that Lodox-MP was NOT developed as part of the Innovation Fund grant. Lodox-MP is the brainchild of De Beers. The Innovation Fund grant was targeted at developing value-added Lodox technology (Lodox-CT and Lodox-TB).

¹³ The clinicians and researchers involved in the clinical trials were predominantly funded by De Beers, not by AMI.

of categories with equivalent conventional radiographs [] Radiation dose was recorded and compared with that in conventional measurements. Turnaround times of patients undergoing digital and conventional X-rays were evaluated. Clinical and radiographic issues were assessed by staff feedback. (Beningfield et al 2003:23)

The results of the trials indicated that Lodox-MP, compared to conventional X-ray systems, produces images that are diagnostically equivalent. The Lodox-MP images were judged superior for mediastinal, lung and soft tissue categories. Moreover, it generated significantly less radiation dosages with substantially less imaging time. A full body scan with Lodox-MP takes no more than 13 seconds, and requires an overall patient time of 5-6 minutes. For conventional X-rays the overall patient time could be up to 48 minutes.

Lodox-CT

Lodox-MP has a C-arm that moves over a horizontal distance of 2 metres (the length of a tall person's body) and rotates axially around a person to any angle up to 90 degrees. The person can be lying or seated during X-raying. The images produced are two-dimensional. Computed tomography (CT) is the technique through which multiple two-dimensional images are mathematically reconstructed to generate three-dimensional data. Mr Potgieter explains the reasoning behind the plan to add CT capacity to Lodox-MP:

We knew and understood that CT, computed tomography, was a very important future and existing development in the medical imaging world. And we believe that if you could make a CT as an add-on and at the same cost levels that Lodox was, it had to be valuable and appropriate. But it was not part of any marketing survey or risk analysis [] it was based on certain published figures about how many CTs there'd be in the future. It was based on consulting trauma surgeons and radiologists saying to them, if you could, in trauma, generate a CT image on the same machine quickly would you, would that be sufficient, now that you wouldn't have to buy a CT. (Herman Potgieter, interview)

However, conventional CT approaches tend to produce distorted images when there is a restricted angular range. Thus, the modification of Lodox-MP to produce three-dimensional images involved a technical risk – underlying structures had to be recovered through incomplete information, which required an advanced algorithm. The development of CT capacity also constituted the innovative component of the project. The eventual algorithm was developed by Mr Mattieu de Villiers, in fulfilment of his MSc in Electrical Engineering, and is based on certainty functions, which is regarded as an ingenious concept. In the interviews with Prof Vaughan and Mr Potgieter the research work is referred to as “blue-sky” research. The algorithm was successfully patented, both in South Africa and internationally (see Sections 3.5 and 6).

In the project proposal to the IF (IF 1999:6), the Lodox-CT component was seen as consisting of five sets of activities:

- (1) to determine the feasibility of algorithms for limited angle CT;
- (2) to develop value adding software for visualisation (i.e. developing the man-machine interfaces);

- (3) to change Lodox-MP to automatically and quickly acquire patient data from multiple angles;
- (4) to develop specialised hardware and software to make everything operational; and
- (5) to conduct clinical trials on the integrated system. In the final report, however, the discussion is restricted to the development of an algorithm for generating three-dimensional data from limited angle projections.

This means that only items (1) and (2) were accomplished. There is still no prototype. On the other hand, the major effort of the CT component of the IF project was initially stated as the mathematical algorithm and its computer application (see Section 3.2)

Lodox-TB

AMI commissioned De Beers to build a second prototype¹⁴, Lodox-TB, which can scan up to four persons simultaneously in an upright position¹⁵. This largely entailed adjustment of the vertical imaging height to accommodate standing subjects. As part of the population-screening component, an automated algorithm to diagnose miliary tuberculosis¹⁶ was developed and demonstrated. It was developed through the principles of computer-aided diagnosis (CAD), i.e. based on a chest X-ray. The research worker involved was an MSc student, Mr Anthony Koeslag. However, the CAD algorithm still needs to be submitted to an extensive clinical trial as well as trials based on a large patient cohort in the Western Cape before it can be widely accepted. These field trials, together with a field implementation strategy for Lodox-TB, were supposed to have happened during the period of funding. It never did. The reason is that the project (and thus the funding) had already ended by the time that Prof Vaughan and his team were finally ready to run the clinical trials. However, by late 2003 Prof Vaughan indicated that the trials for Lodox-TB were still in the pipeline and to be conducted in conjunction with the Lung Institute in Cape Town as well as the Western Cape Department of Health (Kit Vaughan, e-mail).¹⁷

AMI also investigated the possibility of population screening for breast cancer. It formed the topic for an MSc thesis in Biomedical Engineering by Mr Mark Seymour. The investigation resulted in the development of a circular slot X-ray scanning concept for mammography. It is a diagnostic aid that is mounted on the Lodox detector. The scan mammography imaging apparatus was successfully patented in South Africa. An international (WIPO) patent is also in process and an USPTO patent about to follow. Moreover, Prof Vaughan has a mammography grant application pending with the National Institutes of Health in the United States, and mammography is the focus of his grant proposal to the NRF for 2005.

¹⁴ The first prototype was Lodox-MP.

¹⁵ The machine cost R2.7 million and was purchased with the Innovation Fund grant. It is housed in the Anatomy Building at the UCT Medical School.

¹⁶ Miliary tuberculosis (TB) is the widespread dissemination of *Mycobacterium tuberculosis* from hematogenous spread. Classic miliary TB is defined as milletlike (mean 2 mm, range 1-5 mm) seeding of TB bacilli in the lung, as evidenced on chest radiograph. This pattern is seen in 1-3% of all TB cases (www.emedicine.com).

¹⁷ At the time of finalising this case study (i.e. September 2004) Prof Vaughan indicated that the clinical trials project has been revived with paediatricians at the Red Cross Hospital in Cape Town, given that a Lodox system has also been installed at that hospital. The project will be funded by Lodox Systems (Pty) Ltd and probably by THRIP as well.

4.2 AMI's internal and external relationships

AMI and UCT

Once the IF application had been approved, Prof Vaughan informed the Office for Industrial Liaison (OIL)¹⁸ at UCT about the consortium's desire to set up a commercial company. The Deputy Vice-Chancellor for Research and Innovation, to whom the OIL reported, was Prof John Martin. Prof Martin and the OIL were in favour of the idea but expressed three concerns:

[] making sure that they [UCT] negotiated a fair and reasonable equity in the new enterprise, that they were not exposed to unacceptable financial risk, and that UCT academic staff and students would have the opportunity to publish papers and theses. (Kit Vaughan, e-mail)

After the sudden death of Prof Martin, Dr Sibusiso Sibisi was appointed as Deputy Vice-Chancellor. It emerged that Dr Sibisi had been one of the anonymous reviewers of the original IF project application. Right from the start, Dr Sibisi was supportive of the project and brought AMI credibility with the UCT Council and senior management.

UCT normally does not give up its claim to intellectual property developed by university researchers, whether staff or students. In the case of AMI, however, an exception was made because of the university's negotiated stake in the company:

UCT's 'standard' policy is that any IP created while working for the university belongs to UCT. They also have a generous policy in determining the personal financial benefits that can accrue to an individual when the IP is licensed to a third party. In the case of the AMI-UCT agreement, both UCT staff and students gave up their IP to AMI. It was thus a deviation from their standard policy, although AMI did commit itself to providing financial incentives for the creation of IP. (Kit Vaughan, e-mail)

The contractual agreements between UCT and AMI were twofold¹⁹: first, a research agreement between UCT academic staff (in their capacity as supervisors) and AMI, and second, a scholarship agreement between UCT postgraduate students and AMI. These agreements were structured around five core issues.

First, what AMI contractually commits to do:

- ◀ AMI agrees to provide Academic Supervisor a fee for the supervision of student(s) to perform research towards a post-graduate degree (research agreement) / AMI agrees to provide a tax-free scholarship, under the aegis of the University of Cape Town, for Student to perform research towards Student's post-graduate degree (scholarship agreement).
- ◀ AMI further undertakes to reward, on an individual basis, any work performed by Academic Supervisor for AMI that is regarded by the Board of Directors of AMI as having significant commercial value (both research and scholarship agreement).

¹⁸ The Office for Industrial Liaison later became the UCT Innovation Office. The focus of the UCT Innovation Office is on managing contract research activities and implementing the university's vision to "profit from research" through appropriate commercialisation activities (www.uct.ac.za).

¹⁹ A third agreement related to AMI's rental of floor space in the Anatomy Building at UCT.

Second, what AMI regards as confidential information and intellectual property:

- ◀ Confidential Information is information identified as confidential and/or proprietary, belonging to and disclosed by AMI;
- ◀ Intellectual Property is information and/or know-how and/or technology that is of a novel nature and/or has intrinsic or potential commercial value.

It is not:

- ◀ information which Academic Supervisor/Student can show to have been in Academic Supervisor's/Student's possession prior to disclosure by AMI or prior to Academic Supervisor/Student commencing work on the project; and/or
- ◀ information which was in the public domain prior to Academic Supervisor/Student receiving it from AMI; or
- ◀ information which enters the public domain other than by breach of this agreement by Academic Supervisor/Student; and/or
- ◀ information which Academic Supervisor/Student receives lawfully from a source other than AMI.

Third, the acknowledgement that all information and intellectual property developed on the project belongs to AMI and must be protected at all costs:

- ◀ Student acknowledges that in the course of Student's research for AMI, Student may be the recipient of Confidential Information, and/or Student may develop Intellectual Property, alone or jointly with other AMI researchers, and that AMI may suffer prejudice should the Confidential Information and/or the Intellectual Property be made public.
- ◀ Student therefore undertakes to use the Confidential Information and the Intellectual Property solely for the purpose of Student's research for AMI and to maintain the confidentiality of the information.
- ◀ Student understands that Confidential Information and Intellectual Property may be disclosed only:
 - ♦ with AMI's prior written consent; or
 - ♦ to those individuals with a clear need to know for the purpose of the research for AMI, such individuals to be bound by an undertaking of non-disclosure like this one.
- ◀ Student acknowledges that any Intellectual Property developed in the course of Student's research for AMI, whether developed by Student alone or jointly with other AMI researchers, becomes the sole property of AMI. Student agrees to assign such Intellectual Property to AMI and, if so required, to assist AMI in obtaining protection for such Intellectual Property.

(The above is an excerpt from the scholarship agreement – the wording is similar in the research agreement.)

Fourth, a practical arrangement to ensure that the postgraduate students deliver and that the knowledge generated is codified and protected

- ◀ Academic Supervisor agrees to ensure that student(s) keep regular hard-copy notes of research work for AMI, and that such notes, which belong to AMI, are to be signed on a regular basis by a third party, who is also contracted to AMI, for the purpose of protecting AMI's Intellectual Property.

(In the scholarship agreement the postgraduate students committed themselves to keeping these notes books that had to be countersigned.)

Fifth, the process to be followed in order to publish research that belongs to AMI:

- ◀ Should Academic Supervisor/Student wish to publish and/or present any results of research for AMI, Academic Supervisor/Student agrees to give AMI thirty (30) days to review the relevant proposed publication and/or presentation to ensure that no Confidential Information or Intellectual Property is disclosed therein.
 - ◆ Should AMI make no objection to the proposed publication and/or presentation within such thirty (30) day period, Academic Supervisor/Student shall be free to publish and/or present such research results.
 - ◆ Should any Confidential Information or Intellectual Property be disclosed in the proposed publication and/or presentation, AMI and Academic Supervisor/Student agree to work together to produce a modified draft of the proposed publication and/or presentation, which is acceptable to both parties.
 - ◆ Academic Supervisor/Student agrees to delay the proposed publication and/or presentation for a period of up to six (6) months in the event that AMI decides to obtain patent protection for any Intellectual Property disclosed in the proposed publication and/or presentation, to enable AMI to file any relevant patent application.

- ◀ AMI undertakes to use its best efforts to ensure that any delay in publication and/or presentation ... be kept to a minimum. In the case where a thesis or a dissertation may be involved, the delay will not exceed 6 months under any circumstances.

A Masters student could receive an AMI scholarship for a period of two years; a Doctoral student for a period of three years. After that, the student could continue to receive AMI funding but not in the form of a scholarship. It then became a salaried appointment, similar in amount to the scholarship, but where AMI paid the employee's income tax. Seven of the students received funding in this way. The new agreement was between the student and AMI. The reason was to be consistent with national guidelines (2 years of support for MSc and 3 years for PhD). Although the students had to sign away their intellectual property, AMI undertook to reward them on a personal basis should the intellectual property be promising. For instance, Mr de Villiers, who developed the algorithm for the limited angle CT patent, was sent on a paid trip to San Diego, USA, to attend a conference. Being an enthusiastic 'cliffs man', he was also allowed to stop in South America to do some mountain climbing.

Prof Vaughan officially negotiated with UCT on behalf of AMI. His initial dealings were with the Office for Industrial Liaison and the Finance Department. According to him, the

only real frustrations he had with UCT were early in the project, when it took the university a few weeks to transfer the IF money from DST into the AMI account. He also highlights the role of Dr Tony Heher of the Innovation Office as far as the intellectual property issue was concerned, and the involvement of Dr Heher's staff in negotiations with Lodox Systems Pty Ltd regarding the future of AMI (see Section 5.1).

Overall, the relationship between UCT and AMI can be summarised as unproblematic and a mutually beneficial one:

AMI had access to space (for locating its equipment) and scientific expertise (both academic staff and postgraduate students). Though UCT's affiliation with Grootte Schuur Hospital, AMI had access to clinical expertise and patients. UCT benefited by having funding available to recruit postgraduate students, financial incentives for its academic staff who served as project supervisors, the publicity generated by the project, and the shareholding in the company. (Kit Vaughan, e-mail)

AMI and De Beers

What needs to be remembered is that AMI, as a commercial company, was almost insignificant within the scope of De Beers' business dealings. De Beers' core business is in the mining and marketing of diamonds. Therefore, intellectual property concerns are almost exclusively restricted to R&D and innovations in the diamond industry. They are less concerned about technological developments that fall outside the diamond value chain. For that reason De Beers did not mind that the Scannex technology (which developed into Lodox-MP) could 'leave the company', so to speak. Anyway, what could a competitor in the diamond industry do with a medical X-ray system?

However, during the IF grant, i.e. during the active years of AMI, Debex had an annual budget of about R400 thousand for time that its technical staff would spend on AMI projects, for consultation and AMI board meetings. This increasingly became a concern for De Beers:

When all of this started at De Beers, this project, the De Beers itself was fairly, I would say non-focused and hence it was possible to even convince them to worry about a medical product [] With all our latest strategic analyses and plans and whatever, they decided that anything else except focussing on the diamond business is not that good for them. So the fact that inside De Beers there were a team of people using De Beers' sources and De Beers' laboratories that weren't focussed on diamonds caused quite a lot of conflict. It wasn't that easy to deal with. (Herman Potgieter, interview)

During the first year of AMI's existence, De Beers started negotiations with the Industrial Development Corporation of South Africa Ltd (IDC)²⁰, concerning the selling of

²⁰ The Industrial Development Corporation of South Africa Ltd (IDC) is a self-financing, national development finance institution (DFI) established in 1940 by an act of Parliament, the IDC act. It focuses on contributing to economic growth, industrial development and economic empowerment through its financing activities. The IDC has evolved from being a leading industrial player at national and regional levels to being the first South African DFI to have its mandate extended to the rest of the African continent (<http://www.idc.co.za/>).

shareholdings in Debex's Lodox technology. Netcare²¹ also entered the picture and a joint venture was established between De Beers and these two companies. The purpose of this venture, called Lodox Systems Pty Ltd (see Section 5.1), was the commercialisation of the Lodox technology. It would be fair to say that De Beers' concerns for AMI were secondary to those for Lodox Systems. A concern however that De Beers constantly had about AMI was that it should not in anyway does something that will compromise its dealings in the diamond industry. Overall, one could argue that AMI benefited from De Beers more than De Beers benefited from AMI:

De Beers had a really big professional technology base in the area of human imaging and the area of using X-rays and AMI could freely benefit from all of that intellectual property. You know, they had a non-exclusive license to use that and in many cases the AMI staff was trained by working on De Beers premises, on De Beers' equipment [] At the same time De Beers got the benefit of the AMI staff. (Herman Potgieter, interview)

Lastly, the role of the UCT academics on the project is easy to comprehend: they were researchers and acted as supervisors for the postgraduate students. But what role did the four Debex employees (see Section 3.4) play in the project? It was summarised as follows in the project application to the IF:

The Debex team of engineers will be involved at all stages of the project. This includes: the successful commissioning and clinical trials with LODOX-MP; the hardware and software developments needed to convert the LODOX-MP machine into one with CT capability (including real-time performance); and designing and building a new LODOX-TB system. Mr Potgieter will be responsible for overall project management, while Dr Booysen will be the task leader for all electro-optics and X-ray physics on the project. Mr Sousa will be the project engineer for the software and purpose-built electronics modules, while Mr van Looy will be the task leader for all mechanical aspects of the project. (IF 1999:10)

AMI and iThemba LABS

The project collaboration with iThemba LABS was with Dr Jones from the Medical Radiation Group. Prof Vaughan had been collaborating with Dr Jones and one of his colleagues, Mr Nick Schreuder, prior to the IF grant. This paved the way for them to come on board the project, specifically to work on the Lodox-CT component. The role of the Medical Radiation Group was initially identified as using Lodox-CT:

[] for the accurate determination of the exact location of tumours before radiation treatment [and to] determine the potential efficacy of LODOX-CT to produce the specific co-ordinate data for tumour treatment. (IF 1999:7)

The fact that the project did not move beyond the feasibility aspect of the CT algorithm, precluded largely the potential contribution of iThemba LABS (see Section 4.1). In the end, the role of iThemba LABS was mainly restricted to two postgraduate students who

²¹ Netcare is listed on the Johannesburg Securities Exchange (JSE) and owns and manages 62 hospitals in the country. Netcare's hospitals care for an estimated 800 000 patients every year. The group also owns and manages Medicross, comprising 56 multi-disciplinary Medicross Family Medical and Dental Centres around South Africa (<http://www.netcare.co.za/>).

worked on the project. One of them, Mr Greg Flash, investigated the feasibility of using the industrial robot at iThemba LABS to move the X-ray tube of the Lodox-MP system:

Well, we also had some collaboration with the biomedical engineering department [of Prof Vaughan] [] and of course we have some unique facilities here, which is actually not necessarily related to the IF project, but we have a robot here. At one stage they were considering using the robot to move the Lodox. One of the projects was to think of using our robot, or not our robot, but a robot to move the X-ray tube. (Dan Jones, interview)

Well that, we basically, the main part that we actually ended up playing was we had one or two students here that were working on the project. The one actually looked at the robot for example [] So our involvement was mainly with students and as it turned out we didn't get as far as using Lodox for looking at tumours or anything. (Dan Jones, interview)

Apart from Mr Flash, Ms Sue Wynne was the other student whose thesis was relevant to the work at iThemba LABS (see the journal article by Douglas, Wynne and Vaughan in Appendix I).

In conclusion, the role of iThemba LABS in the project was very restricted. In addition, the research group at iThemba LABS didn't actually benefit significantly from the value-added attempts of the Lodox technology, as undertaken by AMI.

We didn't really have much to do with the day to day running of it. We just have to go to board meetings and approve things and make suggestions and that sort of thing. [] we haven't really benefited as such yet from Lodox. I mean, as I said we would've very much liked to have run a Lodox-CT for our treatment planning system and identification of tumours, but that hasn't happened yet. So we haven't actually directly benefited, as such, from the research of Lodox. (Dan Jones, interview)

AMI and MIRU

The relationship between AMI and MIRU was smooth and without tensions. According to Prof Vaughan, AMI is part of MIRU and the largest of its eight projects. This is a perspective that is not necessarily shared by the other AMI shareholders. For instance, Mr Potgieter felt that, for all the time that AMI was run, the fact that MIRU existed was hardly visible and incidental.

None of the MRC funding was applied to the research of AMI, in order to prevent any claims that the MRC might have to the intellectual property created by AMI. This was specified beforehand. Moreover, MIRU benefited from the Lodox system that AMI has bought from De Beers, and which is installed in the Anatomy Building at UCT, where MIRU is located.

There are a number of key pieces of medical equipment that are central to the work of MIRU [] we have installed a Lodox system costing R2.7m in MIRU that has enabled us to extend our research capability in the field of digital X-rays. (MRC 2002:5)

5 Mode of knowledge utilisation

The IF supports technological innovation that will strengthen the country's economic competitiveness. Invariably, it is expected that some outcome of an IF project will be commercialised. Therefore, at some aspects relating to the commercialisation (or lack of commercialisation) of AMI's intellectual property will be discussed. Another reason for dwelling on the commercialisation issue is that the consortium had foreseen significant entrances into the market for diagnostic imaging by the year 2004. This, however, did not materialise.

By the year 2000, the world-wide market for diagnostic imaging will be US\$11 billion, of which X-ray and CT will constitute \$7 billion [] It is quite reasonable to project that within three to five years both LODOX-CT and LODOX-TB will be competing successfully for a share of that \$7b market. (IF 1999:18)

Apart from commercial utility, a brief overview of the clinical and research utility of the value-added Lodox technology that was developed as part of AMI is provided.

5.1 The commercialisation of AMI's intellectual property

When referring to the commercialisation of AMI's intellectual property, one needs to be clear about what sets of intellectual property belong to AMI. According to the final report to the IF, they are the following:

[] the patents on limited angle computer tomography and mammography; the postgraduate theses, including algorithms, software, results and slide presentations; and software written by the AMI staff. (IF 2003:39)

Moreover, the original Lodox technology does not belong to AMI. AMI received a non-exclusive licence from De Beers to use the technology to develop Lodox-CT and Lodox-TB. This means that the right to use the Lodox technology was not exclusively allocated to AMI and expired at the end of 2004.

The project application to the IF does not include a strategy about the commercialisation of Lodox-CT and Lodox-TB. What is said is that the commercial aspects will be the responsibility of the consortium (i.e. AMI) and not that of DST (IF 1999:7). In the final report to the IF, however, a clearer strategy is communicated. According to this, the staff and board members of AMI had a two-day retreat in June 2001, where the future of AMI was discussed. Various options were considered, among which was the raising of second phase funding from a venture capitalist (IF 2003:39). However, this option was rejected.

The venture capital option was rejected because: (1) the De Beers directors felt that a better strategy for AMI was for it to become the R&D vehicle for Lodox Systems (Pty) Ltd; and (2) the time and energy spent chasing after the funds would interfere with our major focus of completing the project according to our original grant application. (Kit Vaughan, e-mail)

In the end, all three groups of shareholders agreed that the future of AMI's intellectual property lies with the Lodox technology and its commercialisation. Thus, it was envisaged that the intellectual property of AMI would be taken over by Lodox Systems Pty Ltd during the latter half of 2003.

When UCT and iThemba LABS sell their shares in AMI to Lodox Systems, it is likely to be in the form of a share swap. The major negotiating point is the current values of AMI and Lodox Systems as these will determine the number of shares that UCT and iThemba LABS receive. (Kit Vaughan, e-mail)

In addition to the brief reference to Lodox Systems in Section 4.2, its relationship to AMI as it impacts upon the commercialisation of AMI's intellectual property will be discussed.

Lodox Systems and its relation to AMI and UCT

As explained, Lodox Systems was launched in November 2001 as a joint venture²² between the IDC and Netcare. De Beers holds 45% of the shares, IDC 45% and Netcare 10%. Lodox Systems is responsible for commercialising the Lodox technology that was developed by De Beers. Mr Potgieter, the Chair of the AMI Board, was appointed as the Chief Technology Officer of Lodox Systems. Consequently, he resigned from the AMI Board. His commercial interests therefore shifted from AMI to Lodox Systems.

In 2002, the IDC and Netcare, performed a due diligence assessment of AMI. The value of AMI, estimated in terms of its earning potential until 2008, was estimated to be about R25 million (IF 2003:39). There were discussions that AMI would become the R&D arm of Lodox Systems. In addition, in 2002 Lodox Systems made an offer to purchase AMI. This was debated at the AMI Board meeting, and Dr Tony Heher, UCT, felt that the proposal was too prescribing and too much directing the research process. Part of the negotiations between AMI and Lodox Systems was that, if Lodox Systems offered to buy AMI, it would also offer employment to the three AMI employees. Although the purchase fell through, the employment offers remained. Two of AMI's three employees (the hardware and software engineers) accepted and moved to Lodox Systems.

By early 2004 nothing has materialised. One needs to ask: why not? One explanation is that Prof Vaughan, the managing director of AMI, had been on sabbatical in Ireland until the end of 2003, and therefore AMI was at a standstill. Nevertheless, there was also another reason, which has to do with the sensitivity of the negotiations between AMI and Lodox Systems. Mostly it related to determining the value of AMI's intellectual property and contribution to Lodox Systems. Mr Potgieter describes the relationship between AMI and Lodox Systems in early 2004 as follows:

Well, at the moment it's fairly strange and I'll tell you why it's strange, because it's not clear [] what proportion of AMI's IP, in other words sellable IP, is going to be directly of benefit to Lodox or not. (Herman Potgieter, interview)

²² Joint ventures, according to Hagedoorn (1990:20), are "companies that have shared R&D as a specific company objective in addition to production, marketing, sales".

Lodox Systems has also gone into direct negotiations with UCT. This has resulted in a contract between Lodox Systems and UCT, to support a new batch of postgraduate students through scholarships. Some of the research projects involve basic research and some are directly related to products. However, Lodox uses the AMI infrastructure as research infrastructure:

The research activities [] the general cooperation with the medical department and electronic engineering, that has been ongoing before and so the concern that Lodox Systems had, because Prof Vaughan went on his year sabbatical, it would lose all its momentum. The Innovation Fund said no, we're not allowed to spend another cent on it [AMI's R&D activities]. So we were in a situation where, just to keep the momentum going, we [Lodox Systems] actually funded the last year, 2003 [] to attempt to continue the activity [] And I do believe we're getting benefit out of that funding, you know. So to some extent we kept the ball rolling and we had the benefit of some of the things started under AMI. (Herman Potgieter, interview)

It's the AMI infrastructure that is being used and we're paying directly for the space in the university, but we're still using the Lodox machine that AMI purchased as a basis for some other research. In fact, we have since investigated some R300 thousand to make it more usable. (Herman Potgieter, interview)

The perceived value of AMI's intellectual property and contribution to Lodox Systems

In fulfilment of the requirements for their Master's theses two postgraduate students created AMI's primary intellectual property. The resulting patents were registered before the theses were submitted and placed in the UCT library. This means that the patents have not been invalidated in any way. However, other postgraduate theses and articles have been published. From the perspective of Lodox Systems it places a question mark behind the competitive value of AMI's intellectual property:

AMI has gone ahead and published a whole bunch of its work in theses and stuff, which is in the public domain, and although we [Lodox Systems] are incredibly sympathetic to recognize the value of it, from a businessman's point of view, why should you buy it if it's in the public domain? (Herman Potgieter, interview)

Moreover, the instances of intellectual property most likely to generate a significant income are the two patents: the algorithm for limited angle CT and the population-screening device for breast cancer. However, Mr Potgieter expressed some reservations with respect to both of these. In the case of Lodox-CT, Mr Potgieter mentioned that although the feasibility of limited angle CT has been demonstrated, the value thereof is uncertain. Even if it can be improved, it does not necessarily mean that limited angle CT would find an application in the medical imaging industry:

On the computer tomography side, the limited angle, it turns out that the research so far has only shown a very limited value [] how can I say value? At the moment it takes sort of like hours to acquire an image because the machine is, you know, is not specifically designed to acquire an image. It

then takes a day or two's computations to produce the image. It's never been tried on a live patient for obvious reasons because as soon as you do CT you have a higher [radiation] dose. [] So I think that if one hunts around long enough, you probably will find in another allied industry, value for some of the algorithms, but I'm not sure whether it will be in medical imaging. (Herman Potgieter, interview)

Whatever the future of the limited angle CT patent may hold, substantial further investments are required to bring it to a product on the market. This is also recognised in the final report to the IF:

Further work must be done to increase the robustness, resolution capabilities and computational speed of the algorithm so that it becomes feasible to apply these techniques in a commercial system. (IF 2003:27)

The future of the patented mammography system, according to Mr Potgieter, is also unclear. It can be either a success or a failure. Further development is required, which would require at least six years.

The mammography, there's a total wildcard. It could end up being really, really valuable or it might not even work ... If it ends up being a valuable patent and if the product, the mammography product can be built, it might have a lot of value, ok, but it requires conservatively another year or two's, call it feasibility evaluation type of search, and then another year or two's product development and then another year or two's compliance, approvals and stuff like that. (Herman Potgieter, interview)

In the case of the X-ray system for tuberculosis, no one is actually going to profit because the focus is on population screening.

So as soon as you talk about population screening nobody's going to be able to charge for these x-rays. So who's going to buy the machine? So to commercialise it is a fairly big step. Technically I think we know we can do it and I think the work of AMI contributed to determining that. It probably did enough work to show that it's going to be viable to do automatic diagnosis of these images, because that's always a problem, you know, you need skills and people. But now to put on a commercial hat and to say who's going to buy this, who's going to pay for it? I mean this has to be governments. (Herman Potgieter, interview)

Thus, one area of negotiation between AMI and Lodox Systems is whether the patents and other intellectual property will be of direct use to Lodox Systems. The answer, according to Mr Potgieter, is debatable. However, one must also recognise the position of Mr Potgieter in the negotiations. He acts in the interest of Lodox Systems, the potential buyer, and therefore the obvious stance to take is to downplay the value or utility of AMI's intellectual property, in order to reduce the price thereof and to get the Lodox Board interested.²³ Concomitantly, one would expect Prof Vaughan, as the seller, to emphasise the potential contribution of AMI to Lodox Systems. Prof Vaughan particularly

²³ Mr Potgieter, in all fairness, has always been a champion of the value of funded research at universities.

dwelled on the immeasurable aspects of AMI's contribution to Lodox Systems, especially the skills embodied in AMI staff working for Lodox Systems.

By March 2004, Lodox Systems has sold two X-ray systems: one to Milpark in Johannesburg and one to the Shock Trauma Centre in Baltimore in the United States. The hardware and software for those products, of which the latest is called Statscan²⁴, were developed by De Beers prior to the IF grant. However, Prof Vaughan argues that a portion of the work that AMI did is in fact in those X-ray systems. In his words:

But I would argue that a small portion of what we've developed as part of our project is in those systems [] What percentage of it is, if 100% is everything, it might be only a few percent. But there is some utility, even if it is the fact that there are employees of Lodox Systems who were previously employees of African Medical Imaging. Some of the work that they did as African Medical Imaging employees during the Innovation Fund grant is almost certainly being employed in these products in the workplace. (Kit Vaughan, interview, 20 February 2004)

Mr Potgieter does not deny it:

You see the whole last year, effectively AMI didn't exist and didn't operate and we funded it and so it's sort of difficult to notionally say what came from where, but I would say [] of the people we have, fifty percent of their knowledge was probably, and background and know-how, probably came out of the AMI days, yes. (Herman Potgieter, interview)

Another manner in which AMI contributed to Lodox Systems is that it assisted the latter to obtain the FDA seal of approval²⁵ for its Lodox technology. Lodox Systems could not have sold the Statscan machine to the Trauma Centre in Baltimore in the United States without FDA approval. AMI did not pay for the FDA approval but, indirectly, played some small knowledge-enabling role. Mr Potgieter explains:

There are soft and hard aspects to AMI's contribution. Because of the fact that AMI ran and kept a lot of imaging expertise alive, we could call on prof De Jager who specifically did it in his non-AMI capacity, because we discussed it with him, to help and assist on developing these [] detective quantum efficiency (DQE) measurements, and he paid one of his students, also not from AMI's funds, to do the work for him. But that's the same student that was working as an AMI student, you know, and so the reason why the AMI student was clued up and could do it was because of the work that AMI helped to do. So, you know, when one works in this collaborative way it's sort of difficult to say in a financial sense, who contributed what. But

²⁴ The Statscan Critical Imaging System is a flexible format digital radiography system aimed specifically at the needs of emergency medical centres and is designed to meet the radiography needs of both trauma patients and standard emergency patients. Comprehensive diagnostic procedures can be completed in a matter of 4-5 minutes and at a greatly reduced overall radiation dose to the medical staff and patients, making it particularly beneficial for use on children and pregnant patients (<http://www.lodox.co.za/>).

²⁵ FDA in the USA is the federal agency responsible for ensuring that foods are safe, wholesome and sanitary; human and veterinary drugs, biological products, and medical devices are safe and effective; cosmetics are safe; and electronic products that emit radiation are safe. FDA also ensures that these products are honestly, accurately and informatively represented to the public (<http://www.fda.gov/>).

certainly in an enabling, knowledge, know-how sense, AMI was very valuable in doing those tests. (Herman Potgieter, interview)

AMI's liability to the IF as a complicating factor

Lodox System's negotiations with AMI are further complicated by the fact that the IF, as funding body, is expecting a return on its investment.

According to the original contract signed by the consortium and the Department of Arts, Culture, Science and Technology (DACST), the Innovation Fund may claim a 5% levy on the royalties generated by the intellectual property developed during the grant period. (IF 2003:6)

Thus, the IF is expecting royalty payments for their three years of funding. Whoever purchases AMI, would also need to take over the liability of royalty payment to the IF. Moreover, the IF might even claim some share to Lodox Systems, which creates reluctance on the side of Lodox Systems to purchase AMI:

AMI has this sword hanging over their heads that the Innovation Fund wants to try and make money out of them and so at the moment AMI is actually a liability because if you touch AMI, the Innovation Fund might want, might want to and they've hinted, that they think they're more of Lodox company, they could have rights in. Ok, and that's creating a serious conflict of interest at the moment and very strange relationships towards AMI or what's left of it anyway. (Herman Potgieter, interview)

Thus, by March 2004, there were various options for AMI.

Either AMI will be bought out completely or AMI will be sealed as a shelf company, put there on a shelf, and they won't have to have board meetings and financial reports etc. It will sit there with its IP and its other assets sitting in it. So we've got some options that we're looking for [] or they [Lodox Systems] may say: 'we'll take over the De Beers shareholding in AMI, UCT can continue with its shareholding, and we'll use it as the R&D vehicle'. (Kit Vaughan, interview, 20 February 2004)

5.2 Clinical research utilisation

AMI has two Lodox X-ray systems that it acquired during the course of the project. The one at Groote Schuur Hospital (Lodox-MP) was donated. The other one in the Anatomy Building at the Medical Faculty (Lodox-TB) is the primary piece of capital equipment bought with the IF money. It cost R2.7 million. Both of these are being used in clinical studies with patients who have suffered trauma, as well as in other studies. One example is a postgraduate student from the Sudan who is using it for a project on scoliosis. Prof Vaughan explains:

One of the fears when you are monitoring children with scoliosis is that particularly in a young woman, a young girl, is that on the one hand you want to monitor if that S-bend is getting worse, quickly, and if it is, you need to go and operate and need to do some treatment. But the only way you can do that reliably is to take an X-ray. The problem is if you take X-rays in adolescent women, you may compromise (a) their ability to have children later on, and (b) of course is the concern about the radiation exposure and

the causing of cancer. So if you've come up with a technique, which Lodox does, of scanning them on a regular basis, accurately measuring what the status of their spine is, maybe every few months, and not exposing them to normal radiation levels, then you've got a very important, a tool [] a tool with a lot of utility. (Kit Vaughan, interview, 20 February 2004)

In conclusion, the two Lodox systems at UCT continue to have a direct clinical utility and contribute to the training of postgraduate students at UCT.

6 Insights derived from this case

At this point, the reader may be confused by the different organisational role-players and their relative position to AMI (e.g. Lodox Systems, De Beers, Debex, UCT, MIRU, NRF, iThemba LABS Medical Radiation Group, IDC, Netcare, DST and IF). Appendix 2 is a cognitive aid that visually displays these organisational structures' relationship to AMI.

AMI, as a commercial R&D company, represents a formalised form of research organisation that places a legal boundary around both a project and a research consortium. It was established as a holding company for the intellectual property created by the consortium in the project. Thus, the purpose was to prevent future problems that could arise about the ownership of intellectual property. The solution (a unique one indeed) was to allocate company shareholdings to the consortium member organisations, based on their respective research contributions (before and during the project), as well as other factors. However, by creating AMI, negotiations around the ownership of intellectual property just shifted to negotiations about the future of the intellectual property, which, in the end, became negotiations about the future of AMI. This resulted in Prof Vaughan, the MD of AMI, being caught in a series of negotiations – not only with the consortium member organisations but also with a joint venture that commercialises the original Lodox technology on which AMI's intellectual property is based. In addition, the project funding body (DST via the NRF and IF) is expecting a return on its investment. All these factors caused Prof Vaughan to remark:

Where it might have been convenient for De Beers to have AMI set up to be this holding company in which the IP would sit, for the university it now sits as a stone around its neck, me in particular. (Kit Vaughan, interview, 20 February 2004)

What lessons can be observed through this particular form of research organisation, especially as it relates to the utilisation of the project output?

The *first insight* is that the allocation of shareholdings in an R&D company to solve the issue of intellectual property ownership does not necessarily imply uncomplicated relations between research partners. Once a company route is followed (not a spin-off but a R&D producing entity), the company becomes a mediating body between the research member organisations. All interactions are then regulated via this entity. These interactions have the potential of becoming strained in the absence of a core feature of a commercial company, namely that of tailoring its outputs to commercial interests. In the case of AMI the academic and research focus was much stronger than the business focus. This placed a question mark behind the commercial viability of AMI, which, in turn,

generated a series of discussions between AMI and its member organisations to reach an agreeable solution about the company's future.

The *second insight*, which picks up from the first, is that too much reliance on the academic mode of knowledge production can be detrimental to commercial utilisation. In AMI's case, at least three things resulted in the academic and research orientation being much stronger than the business orientation:

- a) the absence of a clear business strategy,
- b) the appointment of an academic as the managing director of the company, and
- c) the utilisation of postgraduate students as research workers.

Each of these will be discussed separately:

◀ The first reference to a business plan, in the meetings of the AMI Board of Directors, can be found in the minutes of September 2001, when Lodox Systems entered the scene. Prof de Jager was appointed to write a business plan for AMI, to be finished by mid-February 2002. At the meeting of March 2002, however, the following was said:

Gerhard [Prof de Jager] explained that writing the business-plan is a process. This process is however dependent on a strategy and currently AMI has no clear strategy. Kit [Prof Vaughan] explained one scenario as AMI becoming part of Lodox Systems (Pty) Ltd as their Research and Development arm. Kit also opened the idea of accessing additional funding from other sources that support projects such as AMI's [] Kit also pointed out that AMI has to decide how it wants to position itself. (AMI minutes 2002a:2)

Continuation of funding was a major problem, as AMI was exclusively funded by the IF grant. Therefore, the business strategy was also closely related to a funding strategy. At a subsequent Board meeting in August 2002, as well as during the very last AMI Board meeting in November 2002, neither the status of the AMI business plan nor the funding strategy formed part of the agenda. In 2003, there were no Board meetings because Prof Vaughan was in Ireland. Thus, the issue was left unsolved. Moreover, since AMI is a for-profit company with a strong leg in the university sector, another tension emerged regarding AMI's strategic position. It was worded as follows by one of the De Beers' representatives at a 2002 Board meeting:

André [Booyesen] also highlighted important facts for consideration by AMI, such as whether its main purpose was to make money or to secure future research within a university environment. (AMI minutes 2002b)

In conclusion, AMI, during its active R&D producing years, did not have a clear business strategy. The company's strategic positioning was only to emerge during negotiations with the three consortium-member organisations, the IF (DST and NRF) and Lodox Systems.

◀ The appointment of a full-time university professor as the managing director of AMI meant that the commercial aspects of the project became secondary to the research component. Academics excel in research and training, and have various commitments to their institution, such as serving on departmental and faculty committees. 'Running a business' is a sideline activity that play second fiddle to competing academic interests. At best, for an academic, a commercial or

entrepreneurial endeavour represents a part-time activity. To ensure commercial success, however, devotion is required to the strategic positioning of a company. This is also recognised by Prof Vaughan:

I'm an employee of the University of Cape Town, they pay me to be a professor and to teach and to do research and to do all sorts of other things, serve on committees etc. That takes a certain amount of time. I was also the chief executive officer of AMI, I had three employees to be concerned about and, you know, 15 students and about 15 academic staff and so on. And my conflict was one of time. I knew I should be putting more time into AMI, but I also knew I had other things that needed to be done here at the university and that's where I was conflicted [] I probably should have resigned from the university or at least taken a leave of absence and gone full-time and worked for AMI as an executive managing director, and run the company and really focussed on the business plan, focussed on finding markets and products, opportunities, etc. (Kit Vaughan, interview, 20 February 2004)

Since postgraduate students worked on various parts of the AMI project for degree purposes, the research was automatically shifted into an academic mode. The supervisors were academics, meaning that their research interests guided the selection of student projects. Initially, AMI concentrated on the application of the Lodox technology for only two subprojects: the development of CT capacity and the diagnosis of tuberculosis. Various other subprojects were identified for students to work on, resulting in research in angiography, bone density, robotics, mechanical stress analysis, three-dimensional surface measurement, stereo image reconstruction, and mammography. These projects were neither conceived nor run with a commercial focus in mind. They were born out of research interests and what would eventually produce successful postgraduate degrees. As Mr Potgieter explains:

A lot of the projects needed more specific direction and more circumspection before we funded them. And there needed to be better, more dedicated supervision. You know, the supervisors there, professors Vaughan and De Jager and Beningfield, were absolutely great and they put in a lot of dedication, but they didn't do it from a point of view of commercial viability. They did it from a point of view of what seemed interesting. (Herman Potgieter, interview)

In the case of AMI, then, no direction was given to supervisors or students in terms of the selection of projects with commercial viability. This is in contrast to the new student projects at UCT, which are funded by Lodox Systems:

Let's take the UCT project for instance. You know, we're [Lodox Systems] paying UCT for research because we're hopeful that they're going to contribute to the long-term success of the company and because we can give them direction to do work in areas that we believe will be commercially viable. (Herman Potgieter, interview)

The third and fourth insights both relate to the utilisation of postgraduate students as research workers. The third insight is a positive one: The business-like mode of research

organisation resulted in more stringent controls for postgraduate students, which contributed to research quality. Arguably, this could enhance the eventual academic uptake of these theses and publications. Since professional work was expected of the students, various opportunities existed for student feedback and discussion. Consequently, the students had the advantage of inputs from both industrial engineers and academics representing a variety of disciplines. More specifically:

The students met with their primary advisors on a weekly basis. Then, once a month the whole Cape Town team got together to update each other on the progress of their individual projects. These meetings were informal although students were encouraged to think “out of the box” and to provide input across the disciplines. Every third month, when the Debex engineers came down from Johannesburg to attend the quarterly board meeting, the whole AMI team met on a formal basis. Each student prepared a 15-minute slide presentation ... (IF 2003:38)

It therefore came as no surprise that two postgraduate students, Mr de Villiers and Mr Seymour, created the patented intellectual property. In addition, in terms of the scholarship contract, these students were contractually bound to assist AMI in the patent applications. Thus, the business-like mode of organisation also generated substantial knowledge about patenting among students.

Our fourth insight is that postgraduate students play a crucial role in the successful commercialisation of patents, specifically where students generated the patented intellectual property. This is especially the case for Mr de Villiers, who created the limited angle CT patent that was successfully patented in South Africa and internationally:

For African Medical Imaging to extract the value of that IP, his patent on computed angle tomography, much probably is still sitting in his head and in order for us to get that to the next level, which is either implementing it in a product in computer tomography, in CT, or licensing it to a third party, would require his input, I would think. Even though I read his Masters thesis [] and I read the patent itself, I am not certain that a person, even a knowledgeable person [] could go and implement it. A lot of it is sitting in the software code and almost certainly in his head. (Kit Vaughan, interview, 20 February 2004)

One way to extract the expertise from the postgraduate student is through employment within a commercialisation set-up. At present, Mr De Villiers works for Lodox Systems, but the extent to which his employment draws upon his CT patent is unknown. Probably not so as the intellectual property belongs to AMI and he is contractually bound not to communicate it. On the other hand, practical skills and “doing things at the spur of the moment” are not concerned with contractual boundaries. Nevertheless, Mr Potgieter expressed, in retrospect, the need to codify the skills and insights of the students who generated intellectual property.

I think that everyone of those students should have been contractually bound to stay on an extra month after their thesis is finished and packaged what they’ve done in a commercially valuable way, in other words, every single project, every single bit of research, every single bit of data on a

CD, some sort of friendly demonstration capability, so that someone who isn't technically skilled can take this product to other, to other [] to innovations and venture capital people and say: "Look this is what we can do, this is what we've done". I think that was the single biggest downside. (Herman Potgieter, interview)

Herman [Mr Potgieter] suggested that an initiative should be started whereby students that hand in their final thesis should also hand in a demonstration disk with the "know how" to make the model or software work. Kit [Prof Vaughan] suggested a one to two month post-thesis project with well-defined work task and appropriate payment from AMI. (AMI minutes 2001)

One attempt to codify the insights and knowledge of students can be found in the scholarship contract. The students were requested to implement a notebook system, (see Section 4.2), where they had to keep hard copies of their work to be countersigned. These could then be stored and referred to at any stage by any of the AMI staff. However, this never materialised in practice:

That was poorly conducted because that was, and I am being honest with you now, in retrospect, we tried to run it as a proper commercial set-up where students had to [] were expected to keep a notebook and write everything in a notebook on a regular basis that had to be countersigned. We did not follow through on that. I as the principal investigator was reliant on the other supervisors doing that with their students. And I can tell you, honestly, that that was not followed through properly. (Kit Vaughan, interview, 20 February 2004)

A fifth insight is that negotiations about the market value of a collaborative R&D enterprise, inevitably force contributions of an immeasurable nature to become quantified. Although any debate about the ownership of intellectual property was ruled out from the start, it did not rule out debate about the value of the intellectual property and other immeasurable contributions. Admittedly, this would not have been the case if De Beers did not extend its boundaries to also include Lodox Systems as some sort of spin-off. As a result, any work that AMI did for De Beers on the Lodox equipment immediately became a point of negotiation in AMI's dealings with Lodox Systems. Moreover, since two AMI employees left the company to work for Lodox Systems, it is argued that some of the knowledge applied to the Lodox technology originated from AMI. Another example of an immeasurable contribution is the extent to which AMI assisted Lodox Systems in obtaining FDA approval. During negotiations, then, there is often an inclination to make these immeasurable contributions 'measurable', by trying to express it as fractions of shares.²⁶

The sixth insight is that the mode of research organisation chosen (a commercial structure with fixed shareholdings) implies closure and semi-permanence whereas scientific

²⁶ One could rightfully ask: what in fact constitutes an immeasurable contribution? For instance, the concept of limited angle CT was introduced to the AMI team by Mr Herman Potgieter, who had heard about it at a conference in Denmark. Mr Potgieter subsequently arranged for funding to consult with the appropriate international expert in the field of limited angle CT. Does it also count as an immeasurable contribution?

knowledge production is more open-ended and less structured. Two examples will illustrate this point. The first is that iThemba LABS was allocated a 7% shareholding in AMI based on an envisaged research contribution. However, because of the open-ended and often unpredictable nature of research, their contribution to the project did not materialise as planned. Still, they have the 7% shareholding and could influence negotiations about the commercialisation of AMI's value-added Lodox technology. Secondly, the research consortium has developed through spontaneous interactions (De Beers collaborated with Prof De Jager, and Prof Vaughan collaborated with iThemba LABS, and through Profs Vaughan and De Jager all got linked up). Moreover, the original AMI Boards members (with the exception of the UCT management representative) all came from this natural grouping of collaborators. To the extent that this natural research collaboration is falling apart (e.g. Mr Potgieter and others resigning from the AMI Board), there is the potential danger of ending up with a body of representatives that is held together by mere contractual arrangements without any zest for collaboration.

The seventh insight relates to the previous: potential research partners for a shareholding company should be carefully selected because the mode of organisation does not allow for flexibility once shares have been allocated. Although iThemba LABS was the intended shareholder, they had no legal status and hence the NRF received their 7% shareholding. This wasn't the original plan. In fact, it only complicated things because DST appointed the NRF as manager of the IF – the NRF thus became both funder of and shareholder in AMI. For that reason any decision about their shareholding in AMI would also be influenced by their desire to collect their return on the initial investment. This adds another layer of complexity to the research collaboration and eventual commercialisation of the company's intellectual property:

It's difficult enough having two partners in a consortium. If you add a third one, you just add another layer of complexity, because what are we going to have to do if De Beers or Debex sells its share in AMI to Lodox Systems [] we still have to include them [NRF - iThemba LABS] and then they say, listen, we own 7% of the equity and we don't want to be a part of any share exchange? (Kit Vaughan, interview, 20 February 2004)

The eighth and last insight relates to a previous point made, namely that AMI lacked a clear business strategy. It can be argued that an IF project has a better chance of success (in terms of commercialisation of outputs) if the industry partner is already in business and the project coordinator. In other words, the project must be close to the market from the start. This is what Prof Vaughan did with a second IF project²⁷, which was also approved and has already started to generate revenue on the technology developed. He applied the same model to a third IF application that was in the pre-proposal stage at the time of the interview.

That to me is a better model. And that's why when we have done this third proposal, again we've written the pre-proposal, we've been the main driver because this is what we do, we specialise in writing grants, this is what I learnt for ten years working as a professor in America. But what they do

²⁷ The project title is: "Smart digital cameras based on one-dimensional sensors applied to industrial processing and medical environments." The industrial project leader is Johnson Sensor Technology Pty Ltd (Innovation Fund proposal number: 32340).

much better than the university, is they've been – the industrial partner – they're in the business to make business, to make things and sell them. And so I think that's a better model than the model we have which was to say, there we take De Beers, they've got some technology that they think may be of use, here we've got UCT and together they form this company called African Medical Imaging and then we put an academic as the chief executive officer. That I don't think was a smart move. I think what we should have done is to say can we afford to bring in a real business person, not somebody who is a jack in all sorts of things, teaching, looking after students etc. And that I think in retrospect was the weakness, that we didn't have a business concept driving it, to say that we want to have a product in the market place by x amount of time, and these are the projects that we're are going to do with the students etc. It was much more blue sky, sort of open-ended. So I think I have learnt a lot from the process. Certainly I would do it differently in future. (Kit Vaughan, interview, 20 February 2004)

In conclusion: on the surface AMI does not appear to emerge as a major success story²⁸, if success is determined in terms of the commercialisation of intellectual property developed as part of an IF grant. Various factors have been implicated in this regard, such as the lack of a business plan and commercial focus. However, commercial utility is not the ultimate measure of success. There are also other determinants, among which the creation of a research infrastructure in medical imaging at UCT and the exposure of students and lecturers to the commercial side of R&D. These should all be considered. This case study concludes with the words of Mr Potgieter:

It's a regret that it looks like the ultimate success is going to be [] determined by measurable commercial things, rather than all the soft breakthroughs and the soft interaction and the continuing value to the country of, not directly, but indirectly contributing to the critical mass of medical imaging, of establishing these things, of keeping people in the country [] You know in a similar way that we got value from the synergy at university, they've [UCT] got value from the commercial side and the marketing side and the feedback there. And bringing that practical knowledge to the university, motivating some of the lecturers to think that way, I mean, those are all probably, probably going to in various instances, contribute to some significant things. (Herman Potgieter, interview)

²⁸ The future, however, may prove this statement wrong because a new deal is currently being negotiated between AMI and Lodox Systems, which, in the end, may result in commercial success, as well as profits for UCT.

Data sources

Face-to-face interviews²⁹

Dr Dan Jones (Group Head of the Medical Radiation Group at iThemba LABS).
24 February 2004

Prof Kit Vaughan (Director of the MRC/UCT Medical Imaging Research Unit, Department of Human Biology at the University of Cape Town), 20 February 2004

Telephonic interviews

Mr Herman Potgieter (Chief Technical Officer of Lodox Systems Pty Ltd),
26 February 2004

Prof Kit Vaughan interview (Head of the Department of Human Biology at the University of Cape Town), 6 February 2001 (Interview conducted by Ms Lauren Wildschut)

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Prof Kit Vaughan (Visiting Walton Fellow, University College Dublin, Ireland),
21 October 2003

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²⁹ All face-to-face and telephonic interviews, except for one, were conducted by the author of the case study.

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<http://www.netcare.co.za/>

<http://www.spil.co.za/>

<http://www.tlabs.ac.za/>

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Appendix 1: Project outputs

Patents

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- ◀ De Villiers, MS (2002, January 17) *A method of reconstructing tomographic images*. World Intellectual Property Organisation, International Patent Number WO 02058009, PCTIB0200114
- ◀ De Villiers, MS (2004, April 8) *Method of reconstructing tomographic images*. United States, Patent Application Number 20040066910
- ◀ Seymour, M (2003, March 30) *A scan mammograph imaging apparatus*. South African Provisional Patent number 2003/2247
- ◀ Seymour, M (2003, April) *A scan mammograph imaging apparatus*. World Intellectual Property Organisation, International Patent Number Pending³⁰

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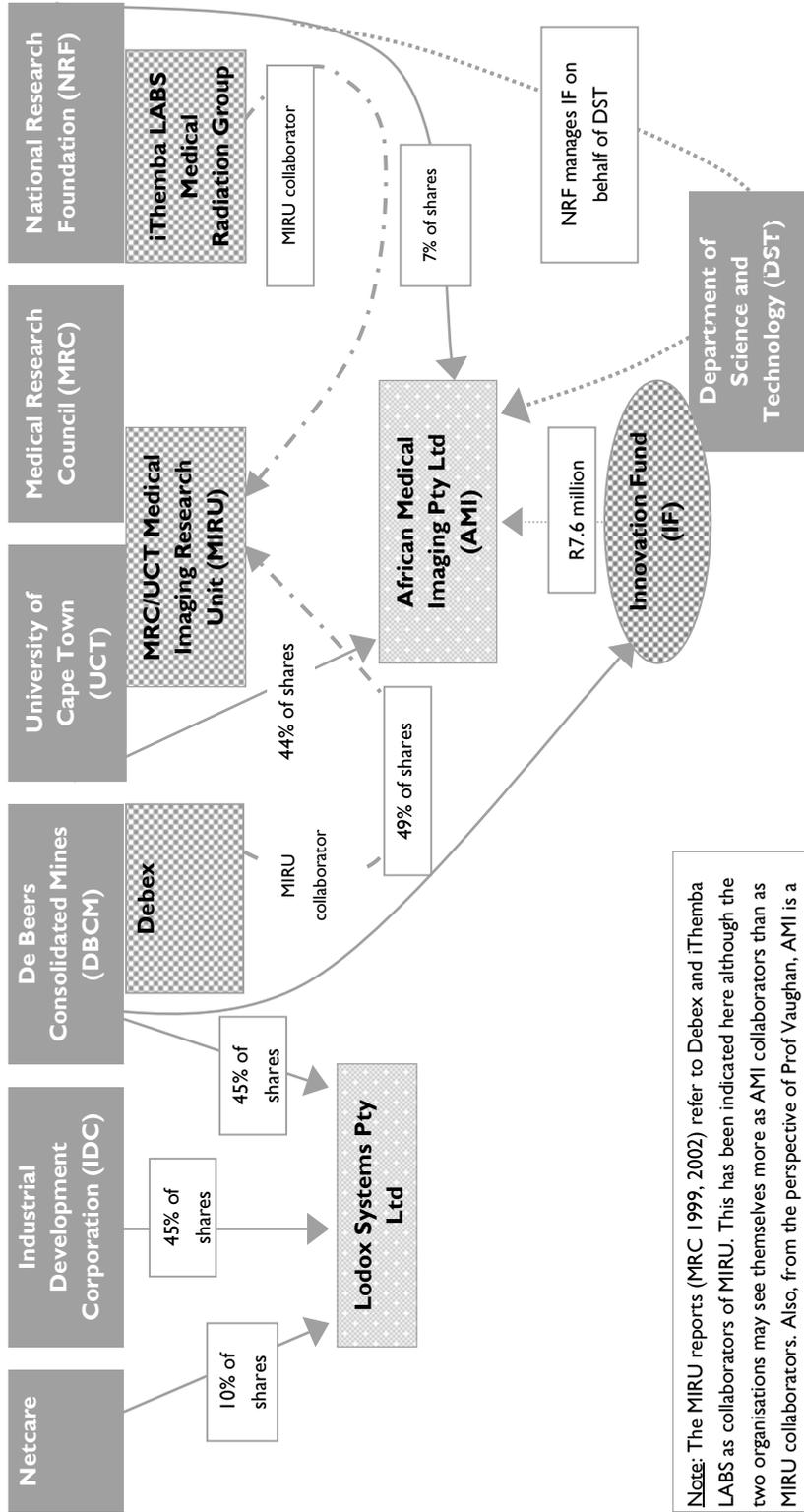
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Other

The project featured in three international television programs: BBC World, National Geographic, and a CNN newscast.

Appendix 2: The different organisational structures and their relation to AMI



Note: The MIRU reports (MRC 1999, 2002) refer to Debex and iThemba LABS as collaborators of MIRU. This has been indicated here although the two organisations may see themselves more as AMI collaborators than as MIRU collaborators. Also, from the perspective of Prof Vaughan, AMI is a MIRU project.

CASE STUDY 6

CAPILLARY ULTRAFILTRATION MEMBRANE TECHNOLOGY AND PROCESS DEVELOPMENT

Pushing the boundaries of higher education research and development

A collaborative series of research and development projects led by Dr Ed Jacobs (Institute for Polymer Science, University of Stellenbosch) and Dr Lingam Pillay (Department of Chemical Engineering, Durban Institute of Technology)

by Tracy Bailey



This photograph of a child drinking water from a tap is courtesy of the Johannesburg News Agency [<http://www.joburg.org.za>]

CONTENTS

Abbreviations	248
1 Introduction	249
2 Ultrafiltration and capillary membranes: The basic concepts	252
3 Organisational contexts	254
3.1 The Institute for Polymer Science, University of Stellenbosch	254
3.2 Department of Chemical Engineering, including the Water Technology Group, Durban Institute of Technology	261
4 Overview of the ultrafiltration capillary membrane and process development for water treatment project	265
4.1 Delineating and mapping the project series	265
4.2 Detailed description of the projects and the research process	270
5. Mode of knowledge production	285
5.1 The collaborative and interdisciplinary nature of the research	285
5.2 The research, development and industrialisation continuum	287
5.3 Research outputs and dissemination strategies	288
6. Mode of knowledge utilisation	289
6.1 The establishment of companies to commercialise the technology	289
6.2 Knowledge transfer through capacity building and dissemination	293
6.3 The generation of new research areas	294
6.4 'Scientific' versus 'user-defined' measures of success	294
6.5 On 'champions' and flexible funding mechanisms	295
7 Concluding observations and lessons learnt from this case	297

Data sources	299
Face-to face interviews	299
Telephonic interviews	299
Email responses to additional questions	299
Questionnaire	299
Appendix 1: Project titles and objectives	301
Appendix 2: Drinking water-related patents	307
Appendix 3: Selected publications	308

Abbreviations

CSIR	Council for Scientific & Industrial Research
CUF	Capillary ultrafiltration
DIT	Durban Institute of Technology
DWAF	Department of Water Affairs & Forestry
EDC	Endocrine disruptive chemicals
FMS	Floating media separator
IPS	Institute for Polymer Science
MBR	Membrane bioreactor
MLST	ML Sultan Technikon
R&D	Research and development
WRC	Water Research Commission

1 Introduction

Of all natural resources, water permeates perhaps most deeply into all aspects of our life. It is as essential as the air we breathe for our very survival; its presence determines the nature of the natural environment in which we live; the majority of our economic activities depend upon it. The achievement of South Africa's development vision will thus only be possible if water resources are managed in a way which is sensitive to and supportive of the many demands which we place upon them. (National Water Policy White Paper, Department of Water Affairs & Forestry, 1997)

The Bill of Rights, enshrined in the Constitution of the Republic of South Africa (1996), holds that all South Africans have the right to have access to sufficient food and water. However, South Africa is an arid, water-scarce country with an average rainfall in the region of 500mm per annum – which is below the world average. In addition, the rainfall is unevenly distributed: around one-fifth of the country gets less than half the average (approximately 200mm per annum). According to the National Water Policy White Paper (Department of Water Affairs & Forestry 1997), South Africa is threatened by a water crisis:

With just over 1200kl of available freshwater for each person each year at the present population of around 42 million, we are on the threshold of the internationally-used definition of “water stress”. Within a few years, population growth will take us below this level. South Africa already has less water per person than countries widely considered to be much drier, such as Namibia and Botswana. (DWAf 1997)

Water shortages are not the only problem, however. Not everyone has access to clean and safe drinking water, or to proper sanitation. According to the White Paper (DWAf 1997), in the mid-1990s, around 14 million people did not have access to safe drinking water, while more than 20 million did not have access to adequate sanitation. This problem was, and is still; particularly acute in the rural areas, where less than 20% of poor households had access to piped water or sanitation (May *et al* 1998:9). Poor sanitation significantly compounds the problem since it often leads to serious pollution of ground and surface water (Jacobs *et al* 2002:xi). According to Jacobs *et al* (1999:xi-xii), “Microbiologically polluted water has long been associated with the transmission of gastro-enteritis, cholera, typhoid fever and other infectious diseases.” The health implications are therefore dire. A CSIR media release (2 November 2002) reported that “water related disease is responsible for an estimated 43 000 deaths per annum in South Africa”, many of whom are children (DWAf 1997). This in turn reduces people’s “quality of life and productive capacity” (May *et al* 1998:8-9).

Between 1994 and 2004, the first decade of democracy in South Africa, the new government has delivered clean water to 10 million people, who did not have access during the apartheid era. This is a significant achievement. Nevertheless, according to Mr Ronnie Kasrils, Minister of Water Affairs & Forestry, in 2004, there are still “... some 5 million people obtaining water from rivers and springs and some 16 million people without adequate sanitation facilities” (Kasrils 2004).

The Department of Water Affairs and Forestry published minimum potable water-quality guidelines for South Africa in 1996. According to Jacobs *et al* (1999:xi-xii), this “was to ensure that the bacteriological quality, the appearance and chemical quality of the water is of an acceptable standard to protect human health.” However, in most rural areas, and other small, remote towns, water treatment and the monitoring of water quality is negligible or even non-existent (CSIR Media Release, November 2000, <http://www.csir.co.za/>). In addition, poorer households are unable to afford the most basic water treatments.

In small rural communities the water used for household purposes is frequently not treated at all, or only filtered and occasionally disinfected with liquid or solid chlorine compounds such as sodium hypochlorite or calcium hypochlorite. This scenario, however, not only applies to rural communities because more than often, water supplied to small towns or a seaside village is also treated in this unsophisticated manner. Some of these plants may only have a part-time operator to keep them running, and may use very basic treatment processes such as filtration and disinfection. Some, however, do employ full time operating staff and use better treatment processes such as chemical coagulation, flocculation, sedimentation, sand filtration and disinfection. (Jacobs et al 1999:2)

According to Jacobs *et al* (1999:xii), there are three ways in which drinking water can be treated in order to remove the microorganisms that are a threat to human health. These include: physical processes (e.g. gravity separation, filtration and ultrafiltration); physical agents (e.g. boiling, ultraviolet sterilisation); and, chemical reagents (e.g. chlorine chemicals, ozone, iodine).

There are problems associated with most of these methods. For instance, while sand filtration is able to achieve a level of natural disinfectant, the performance of the filters is not always optimal: “Poor maintenance of these systems, loss of filter media over a period as well as infrequent washing of the filters can result in sub standard performance and reduced efficiency of disinfection” (Jacobs *et al* 1999:xii). There are also problems with the use of chemical treatments, not least of which is the concern about the damage they cause to the environment. In addition, chemical treatments are not always that effective:

The most popular chemical disinfection agents in South Africa are chlorine gas on a large scale and hypochlorites for small scale water treatment operations. However, the presence of suspended matter and colloidal turbidity in untreated water can protect microorganisms from effective disinfection and can stimulate bacterial growth. (Jacobs et al 1999:xii)

Increasingly around the world, researchers are turning their focus to research and development in the use of membrane filtration methods (including microfiltration, ultrafiltration and nanofiltration) as an alternative treatment for drinking water. According to Jacobs *et al* (2002), this drive has been given further impetus since Australia, Europe, North America and Japan have imposed more stringent water regulations.

Dr Lingam Pillay described some of the factors leading to this renewed focus on the use of membrane filtration on drinking water:

Membranes for desalination, in other words, for treating seawater, they've been going for some time. Using membranes like we're using them for drinking water production, that's the one that's fairly recent. I think there have been three drivers. One of them is education; people know about membranes and what they can do, it's not something completely new. Two, environmental considerations. [] Membrane is the only technology that can guarantee that all of those [microbiological organisms which carry diseases] will be removed. And the third driver has been the economics, the decrease in the cost of membranes. Whereas a few years ago membrane systems could have cost twice conventional systems; now membranes are either slightly above, or even more competitive. (Lingam Pillay, interview, 15 June 2004)

Of the various membrane technologies available, including micro- and nanofiltration, ultrafiltration membrane technology is regarded as having particular benefits – both in terms of the good water quality that it is able to achieve in the treatment of drinking water, and in terms of it being an appropriate and cost-effective technology for rural areas.

Although ultrafiltration membranes are not as productive as microfiltration membranes are, and are operated at a slightly higher transmembrane pressure, ultrafiltration is slowly becoming the preferred process because of the smaller pore size of ultrafiltration membranes. The WRC proved foresightedness in their support of the endeavour to develop a RSA ultrafiltration membrane technology for potable water treatment. (Jacobs et al 2002)

The focus of this case study is on a series of research projects, funded primarily by the Water Research Commission (WRC), and undertaken in collaboration between researchers at the University of Stellenbosch and the Durban Institute of Technology. This research has resulted in the development of a membrane technology that is able to address many of the issues relating to the treatment of drinking water outlined above. The original aim of early projects in the series was to develop a “new membrane filtration process for treating water from non-saline sources for drinking purposes” (Jacobs et al 2002:i). Among the objectives was to find a way of avoiding the use of any chemicals “upstream of the membrane filtration operation, and that chlorine would only be used to maintain the disinfection levels guaranteed by the membrane filtration process” (Jacobs et al 2002:iii). In addition, the technology needed to be cost-effective and require low-maintenance, to suit local rural conditions. As this case study will outline, the series of projects that emerged over the next ten years extended far beyond the original objectives laid out in the contract with the WRC, proceeding beyond the phases of research, and process and systems engineering, to industrialisation and even technology transfer for commercialisation (Jacobs et al 2002:iii).

Since most readers of this case study might not have a background in polymer science or chemical engineering, basic definitions of the key processes and technologies that form the core of the research and development are discussed in brief.

2 Ultrafiltration and capillary membranes: The basic concepts

Instead of using chemicals to disinfect water, or gravity to filter particles from the water (as in the case of sand filtration), ultrafiltration is the process whereby unwanted microorganisms are effectively sieved out of the water. The technology on which this process is based is known as membrane technology. To the uninitiated, the membranes look like narrow, flexible straws, which can vary in length (Figure 1). The pores of the membrane (the 'holes' in the 'sieve') are nano-sized (20 to 50 nm) and, as such, are smaller than the unwanted microorganisms, but large enough for water molecules to pass through. The following quotes provide a more technical description of the membranes:

An ultrafiltration membrane is a membrane that effects separation on the principle of sieving. The membrane has pores that are in the nanometre size range, and will therefore prevent particles, colloids, microorganisms and dissolved solids that are larger in dimension than the pores in the membrane surface from passing. The membrane therefore acts as a physical, size-exclusion barrier, and it is for that reason that ultrafiltration membranes produce such a high quality product. (Jacobs et al 2002:i)

[Ultrafiltration] membranes are surface filters and not depth filters like sand filters. It is the properties of the membrane surface at the membrane/water interface, which govern its retention and flux performance. No chemicals need to be added to the feed stream to flocculate contaminants in order to remove macromolecules (i.e. colour reduction), colloids and suspended solids (i.e. clarification) or microorganisms (i.e. disinfection). (Jacobs et al 1999:3)

Figure 1: Capillary membranes



Source: <http://www.vulamanz.co.za/specs.htm>

The membranes are housed in a cylindrical tube that is known as a module (Figures 2 and 3). The modules are placed together in an ultrafiltration system for water treatment (Figure 4).

The process has the advantage that it is modular and can thus easily be scaled up to suit increased capacity requirements. It therefore provides a valuable alternative to the more conventional technologies to provide a high quality filtered product. The process appears to be particularly suitable for small to medium scale applications where it could be used to produce

potable water for small and farming communities, schools, hospitals and clinics. (Jacobs et al 1999:3)

Figure 2: Side view of module for housing capillary membranes



Source: Photograph courtesy of Richard Mackintosh

Figure 3: Top view of module with membranes inside



Source: www.vulamanz.co.za/specs.htm

Ultrafiltration is particularly appropriate as a water treatment option for potable water in rural communities and the reason for this is that it is able to clarify and disinfect water for potable use in “a single-step operation without the use of chemicals” (Jacobs et al 1999:1). In addition, the quality of the water produced from the ultrafiltration treatment does not depend on the skills or aptitude of the operator:

It is very important to note that the quality of the product is neither a function of the feed water quality, nor of the skills level of the operator. This has a direct bearing on the use of ultrafiltration as a small-systems option to treat non-saline water in remote areas, and its ability to provide a quality filtered water. (Jacobs et al 2002:iv)

Figure 4: Capillary ultrafiltration membrane and module system



Source: www.vulamanz.co.za/contacts.htm

Before proceeding with an overview of the series of projects around the development of the capillary ultrafiltration membrane technology, the two primary organisational contexts within which this research and development has taken place; namely, the Institute for Polymer Science (University of Stellenbosch) and the Department of Chemical Engineering (Durban Institute of Technology) are considered.

3 Organisational contexts

The collaboration between researchers at the University of Stellenbosch and the Durban Institute for Technology was one of the first such collaborations between a previously advantaged university and a previously disadvantaged technikon. The two institutions have vastly different histories, structures and research cultures, and these are outlined in brief.

3.1 The Institute for Polymer Science, University of Stellenbosch

Organisational structure and funding

In 1977, the informal research group around polymer science within the Department of Chemistry at the University of Stellenbosch was granted the status of 'institute' by the Van Wyk de Vries Commission, and the fledgling 'Institute for Polymer Science' emerged. In those early days, the Institute was financially self-supporting and some staff members, such as Ron Sanderson and Andy Roediger, undertook trouble-shooting for the local polymer industry to generate much-needed funds. In 1982, the Institute took on a new structure with two clear dimensions: an academic institute which focuses on basic research and postgraduate teaching (involving individuals such as Prof Ron Sanderson, Dr Ed Jacobs and Dr Derrick Pienaar), and a private group (Roediger Agencies) which deals directly with industrial needs. Prof Sanderson described the working relationship between the two groups as follows:

[Andy Roediger] runs the trouble-shooting for industry. He takes all the court cases on; he takes all the outside work on. What I do is I provide all the University equipment to him. But in the meantime, he's

put in about R20 million of equipment himself. So we share between him and me. And he provides what we call a community service. He provides a massive community service. For every little person that's out there that's got a problem in polymer, they come to him. (Ron Sanderson, interview, 18 May 2004)

The kinds of requests that come from industry, which Roediger Agencies handles include, or example,

[] to characterise what they're making at the moment, or to change the catalysts that they're using at the moment, or to modify the polymers that they're using at the moment, or to solve their problems in, say, science for advertising or carpets for the floor, or whatever. So that's the type of projects we get. (Ron Sanderson, interview)

Prof Sanderson also gave an example of the more community-oriented work that Mr Andy Roediger tackles:

There were two school teachers. One of their kids got hit by a car. They didn't like it. So they started getting this glow tape to put on the back of takkies, putting it on the back of drill pants and that. They wanted help so they came to him and he helped them in finding the right material and finding the way to Velcro it on or sew it on. They've got a big business running now. (Ron Sanderson, interview, 18 May 2004)

This dual structure – an academic body focused on basic research and postgraduate students, and a self-supporting unit which engages in problem-solving for industry – is still in place today; except that now three other private companies with which the Institute interacts closely are also located in the Institute for Polymer Science building, namely Mondi, Plascon and Accent Manufacturing.

Currently, about 50% of the Institute's funding comes from industry in the form of contracts, as well as financial support in the form of bursaries and donations. The other half comes from government and statutory bodies, such as the Water Research Commission, and the National Research Foundation (via funding mechanisms such as THRIP, SPII and the Innovation Fund). The Institute also obtains funding from the governments of other African countries.

The Institute for Polymer Science has a broad postgraduate base. In fact, all the researchers in the Institute are postgraduate students. This was not always the case, however. In the early days, when the Institute was financially self-supporting and focused almost entirely on undertaking industrial projects, student numbers were negligible. It did not take long, however, before the Institute had generated sufficient funding from industry to set up the infrastructure for postgraduate teaching and research. In 1981, the first honours / MSc degree in the Institute was approved by the Senate of the University of Stellenbosch. It was the only degree programme in polymer science in the country and was applied for at that stage with money from industry (R277 000 in 1980 which paid for a senior lectureship for five years).

A major turning point in the Institute's history was the award of the UNESCO Associated Centre for Macromolecules and Materials in 1996. (The objectives of the Centre are listed in box I.) According to Prof Sanderson, there are currently thirteen such Associated Centres around the world, all of which focus on a particular aspect of chemistry.

Box I: Objectives of the UNESCO Associated Centres for Macromolecules and Materials

- Provide a structure for the development and dissemination of educational material in macromolecules within Africa, and especially within the South African Development Community
- Assist foreign scientists and students in obtaining funds from international and individual member government agencies, to enable them to spend time at the Centre
- Provide the infrastructure for specialised analytical courses
- Provide analytical infrastructure, library facilities and know-how for collaboration towards research output, and
- Organise annual conferences to attract experts in macromolecules from around the world and provide opportunities for others, both local and especially from developing countries, to interact with these experts.

Source: www.sun.ac.za/unesco/UnescoCentre/Stellenbosch.htm

The award of the UNESCO Centre does not bring any funding or structure to the Institute. However, having this UNESCO status immediately gave the Institute for Polymer Science a strong international dimension, and the Institute has since grown from strength to strength. One of the main consequences of the award was a massive increase in student numbers, and particularly amongst foreign students. The increase in student numbers brought with it a greater funding commitment from industry and allowed for expansion in terms of staff numbers and equipment. The UNESCO Associated Centres interact and work together frequently, which also reaps rich rewards. Prof Ron Sanderson described the range of benefits as follows:

Our PhD turnover has been extremely high and because of this, we've also been able to get a lot of industrial money, and then put in all the infrastructure we need. We've got enormous infrastructure. And so we compete with Europe and the States in terms of what we can offer now in the industry. I've just had a quotation bid against Oxford University and won! So, you can do things like this. What's interesting at the moment is, we've got a good staff, so we've got a wider range of activities that we've had since opening this UNESCO Centre. It's allowed us – because of the larger student numbers – to get more staff members and, therefore, to have staff members ... in '95 I was alone here; now there's five major staff members and altogether something like 17 staff members paid from research or the University. [] But the main thing that UNESCO does, it allows you to negotiate, via UNESCO, with international governments, because UNESCO gets about four ministers a week visiting it for aid, and then UNESCO will often send the ministers to talk to our Centre, if they are interested in this particular area. (Ron Sanderson, interview, 18 May 2004)

While these are clearly signs of success, Prof Sanderson pointed out that the expansion has also created new problems:

Everyday I've got about two or three applications internationally. At the moment, I've got applications for twenty, thirty students with funding from overseas nations, but I've just got no space. I just can't take on any more students. We've got too many at the moment and we've got huge space limitations. In fact, we've got one project, and I haven't got space for them. I have to now go and hire buildings outside the University to teach. So, it's got a bit wild. (Ron Sanderson, interview, 18 May 2004)

The Institute maintains a wide range of international linkages and is involved in a number of joint programmes in countries such as The Netherlands, the United States, Germany and Russia. Examples of joint programmes include:¹

- ◁ With Prof Koos Jansen of the Delft University of Technology (The Netherlands), around zeolite research
- ◁ With Prof B Klumperman of the Department of Polymer Chemistry and Coatings Technology at Eindhoven University in The Netherlands, around emulsion and tailored polymers
- ◁ With Prof LJ Mathias, Department of Polymer Science, University of Southern Mississippi USA around metallocenes and multimedia programming.

There is also a wide range of informal collaborations with scientists from universities in other countries.

Nature and organisation of research

According to Prof Sanderson, about 90% of the research undertaken by the academic arm of the Institute is basic research. However, this kind of basic research does not conjure up images of scientists working away in their laboratories, isolated from the rest of the world. As Prof Sanderson put it: "Our claim to fame has always been that we work with industry." (Ron Sanderson, interview, 18 May 2004)

Only two people of the current staff of 120, are involved in what Prof Sanderson refers to as "applied research". However, as he points out, significant applied work is taking place within the corridors of Roediger Agencies, Plascon, Mondi and Accent, located on the lower floor of the Institute building.

Prof Sanderson also described the research in the Institute in terms of having either an "industrial" or a "non-industrial" focus:

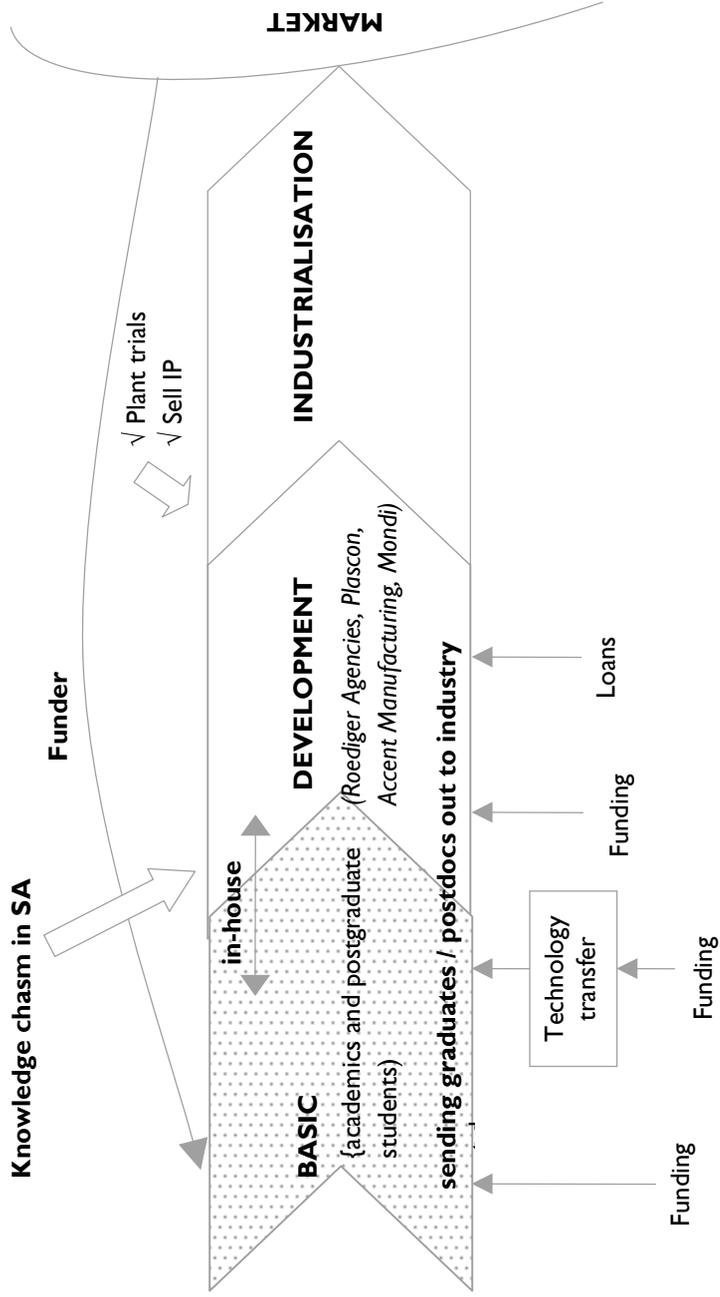
Polymer science is an interdisciplinary area. So we do industrial work and non-industrial work. Our non-industrial work tends to be interdisciplinary where we support other divisions at this University, or at other universities; but also, we support industry. And I would guess it's about a fifty-fifty mix. (Ron Sanderson, interview, 18 May 2004)

¹ <http://www.sun.ac.za/polymer/collab.htm>

Figure 5 is Prof Sanderson's visual depiction of where the Institute's research activities (largely the shaded area of basic research) are concentrated within the process of innovation. He indicated that there is a lack of skills in South Africa to cross the "knowledge chasm" – that is, the transfer of technology from basic research through to development. At the Institute, this is addressed in two ways – either by sending students or postdoctoral fellows out into industry, or by researchers crossing that line themselves:

If industry doesn't do the next part and take it through into development, then we often take it through to development. This membrane work now is straight through to development. All Dr Jacobs' work is straight through to development. (Ron Sanderson, interview, 18 May 2004)

Figure 5: The role of research at the Institute for Polymer Science in the innovation process



Given their close interaction with industry, it is not surprising that the Institute's research agenda is strongly influenced by industry. Once a year, a group of industries meet to discuss the Institute's research programme. However, ideas for research projects also come from academics and flow out of current work.

The major thing is discussions between the university and industry. Industry has certain wants and needs. Often they modify these needs and the university is freer. Normally it's a mixture of the two holding hands and deciding what to do. Quite often they'll come with an area they're interested in training the students into for the future. At other times the University has lots of new ideas. Often, as a project moves, ideas are generated. These are fed back into the meetings we hold. A lot of the seeds are created by the academic environment. (Ron Sanderson, interview)

The research agenda is constantly changing because of the ever-changing needs and priorities of industry.

It's changing every single year. We have to be on the cutting edge. Industry changes all the time. It wants to be on the cutting edge. It changes changes changes. You create research areas and then when they become mature you let them run with the champions that started it. You've got to create projects that have a chance of going commercial and creating jobs. (Ron Sanderson, interview)

While some of the research focus areas in the Institute are well established (such as the membrane technology development), new ones emerge around the needs of industry and /or the research interests of individual researchers. Examples of current research areas include:²

- ◀ Emulsion polymers for coatings and reinforcement (RD Sanderson, L Klumperman)
- ◀ Metallocene catalyst preparation, catalyst usage for polyolefin synthesis (AJ van Reenen, HG Raubenheimer)
- ◀ Ultrafiltration process and systems development (EP Jacobs, VL Pillay, P Swart, M Pryor, SM Bradshaw, JP Botes)
- ◀ Membrane-based biotechnological systems for treatment of organic pollutants (PD Rose, W Leukes, SG Burton, EP Jacobs)
- ◀ Membrane-based electrochemical sterilisation of water (DG Bessarabov, RD Sanderson, C Nel, AM Crouch), and
- ◀ Desalination by means of solar distillation (I Goldie).

In addition, there are a number of student related research projects.

The Institute has secured numerous patents over the years. These are listed on the web site (<http://www.sun.ac.za/polymer/Patents.htm>).

² www.sun.ac.za/polymer/research.htm.

3.2 Department of Chemical Engineering, including the Water Technology Group, Durban Institute of Technology

Dr Pillay was a staff member of the Department of Chemical Engineering at ML Sultan Technikon in Durban when his collaboration with Dr Ed Jacobs first began. Since then, in 2002, the ML Sultan and Natal Technikon merged to form the Durban Institute of Technology. Developments in both institutions are therefore briefly discussed.

Nature and organisation of research

One of the significant differences between universities and technikon in South Africa is that while many of the universities – and especially the older, ‘white’ institutions – have well-established research cultures, research at technikon only really began to emerge in the mid-1990s. In fact, when Dr Lingam Pillay moved from the University of Natal to the ML Sultan Technikon in 1995, one of his primary challenges was to set up a research infrastructure around membrane technology. Dr Pillay facilitated this by continuing to work on the projects that he had been working on at the University of Natal, in his new position at the Department of Chemical Engineering at the Technikon. The idea was that the Technikon group would focus more on the applied projects, while the Group at the University of Natal would focus on the fundamental research.

So, it wasn't so much a question of my leaving Natal, we viewed it as just extending our ambit as such. (Lingam Pillay, interview, 15 June 2004)

Prior to the merger with Natal Technikon, Water and Membrane Technology was one of the research focus areas within the Department of Chemical Engineering at ML Sultan Technikon. Not long after he joined the Department, Dr Pillay's research group decided to give itself an identity – the Water Technology Group:

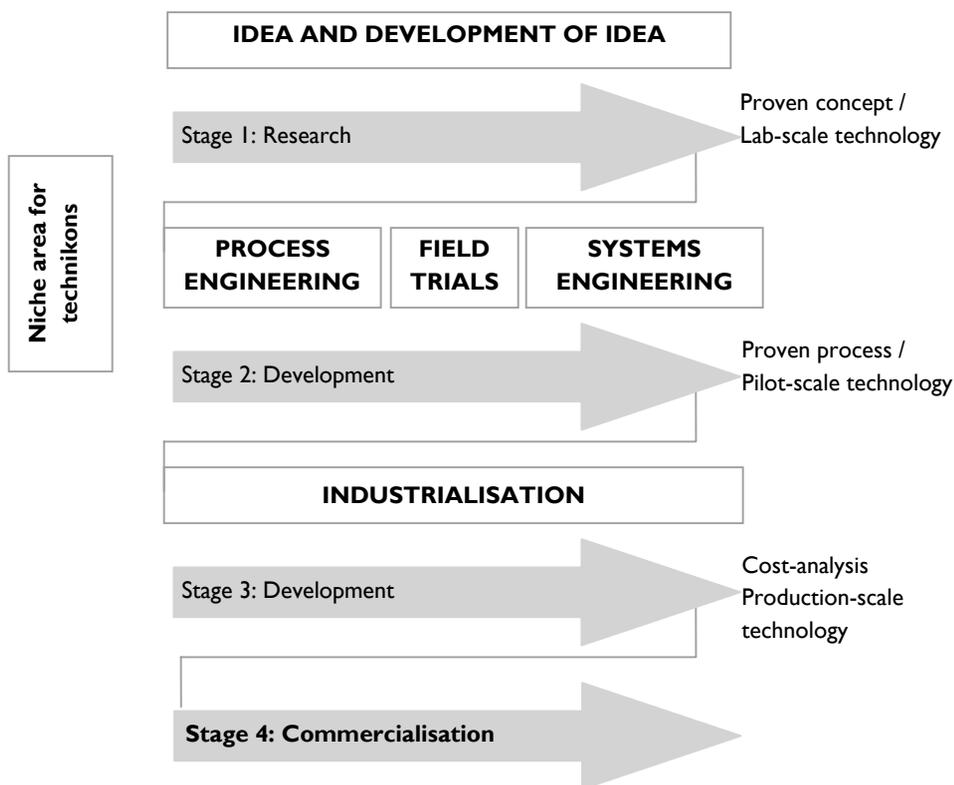
When we started off in the Department, after a short while we decided to give ourselves some sort of identity. You know, just talking about ‘Department of Chemical Engineering’ didn't emphasise our focus on water. So initially we called ourselves the Water and Membrane Technology Group. It was just a name; it just existed in the Department. Thereafter we shortened it to the Water Technology Group, just as an identity. Well, particularly at conferences and things, there has been some recognition of the name. So, it's not a formal group, it just exists in the Department. (Lingam Pillay, interview, 15 June 2004)

There was a similar focus on water and membrane technology in the Department of Biological Science at the Natal Technikon. Therefore, the National Research Foundation said that the two groups needed to combine after the merger. A new focus area was thus formed, namely Water and Waste Water Technology. According to Dr Lingam Pillay, until about mid-2002, the major research focus within the Department was water. Since then, some new focus areas have emerged from the work of certain individuals, for example, cleaner water production through metal finishing in the metal industry; membrane bioreactors; and, vapour liquid equilibrium. There are also a number of smaller projects at BTEch level.

In order to facilitate his description of the nature of the research and development activities within the Department of Chemical Engineering (and thus within the Water Technology Group), Dr Pillay showed the author a diagram that he uses when making presentations, which illustrates his and his colleagues' understanding of the different stages of the development of a technology (or, the innovation process). Figure 6 is an adaption of this diagram. Dr Pillay described the various features of the diagram as follows:

The first stage is basically, someone comes up with an idea, you undergo some degree of development and you end up with what we would call a proven concept, which is maybe a thing that big in the lab [indicates something small] where you've proven that the concept works. The next stage is what we would see as process engineering, turning that small thing into a bigger thing, doing field trials or whatever it may be, and then ending up with a system, which then says the process has been proven, as opposed to the concept. And that we broadly term process and systems development. The third part of that would be industrialisation, which is turning that into a reasonably packaged type thing, doing the economics, pulling together a complete package, which will end up as a commercial product. (Lingam Pillay, interview, 15 June 2004)

Figure 6: Dr Pillay's diagram depicting the innovation process and the potential niche area for technikonis



According to Dr Pillay, Stage 1 is 'research' (defined as work that results in publications and theses, for example), while Stages 2 and 3 are 'development'. Dr Pillay does not define Stage 1 (research) as "basic research". He explained these distinctions in the context of chemical engineering:

Basic research in my field, what I would define it as there, is coming up with a new type of membrane, a different chemical structure. That's what I would call "basic research". Now that is something that Ed is the only one who can do. Anything else in what we do, I would call it "applied" because it is actually research meant for a particular problem. (Lingam Pillay, interview, 15 June 2004)

The postgraduate students in the Department are more involved in what Dr Pillay refers to as "fundamental" research, which, for Dr Pillay, is not as low a level as "basic" research is. Students work on broader projects, which might include the design and construction of a technology, but it must also include a fundamental, investigative component in order to meet the requirements of a Masters degree.

Dr Pillay also has a very specific idea about the role that technikons and similar institutions can play within this innovation process. He argued that most research that is done by higher education institutions in the country tends to stop after Stage 1; namely, at the point of proving the concept. These research results are usually disseminated in the form of publications, conferences, and Masters and PhD theses. In an ideal society, Dr Pillay says, at this point industry would take up the research findings and, through their own R&D efforts, take the concept or the nascent technology to the point of industrialisation (i.e. through Stages 2 and 3). However, according to Dr Pillay, most industries in South Africa do not have the capacity to undertake their own R&D. He therefore sees a role for technikons (since 2004 referred to as 'universities of technology') in the process engineering and systems development stage, to produce a product that is much closer to being commercialised.

In South Africa we have the problem of, we do not have sufficient companies with the resources to be able to do that. Particularly if you look at water, there's virtually no-one that actually spends a significant amount on R&D. So, they're not prepared to go through that. To increase the possibility of it getting to a product you need to go through at least the second stage, and this is what I see as the forte of the technikon. Not only in water, but also in general, which is taking things that people have got in the laboratory, turning that into a process, evaluating it, coming up with a system, such that you've proven the process. (Lingam Pillay, interview, 15 June 2004)

The idea is therefore that technikons take the proven concepts from research further to the point of process and systems engineering (Stage 2). During this process, however, new ideas, problems and puzzles emerge which are then taken back to Stage 1. In some cases, the Department will do this themselves.

Funding sources

Recently, the majority of the funding for research is obtained from the Water Research Commission, some of which comes from the University of Stellenbosch via collaborative

projects with Dr Ed Jacobs. A much smaller but significant proportion of the Department's funding comes from the National Research Foundation, in the form of running expenses and capital, as well as postgraduate bursaries and scholarships. Given that many students work on WRC projects, some of the WRC funding is indirectly used to boost student support. Salaries are paid by the Durban Institute of Technology. The Department has made two applications to the Innovation Fund, but both were unsuccessful.

Within the Water Technology Group, early funding came from the projects attached to the University of Natal. According to Dr Pillay, increasingly the Group made efforts to bring in their own funding. The first project that the Group secured in its own right was for the Atomic Energy Corporation for, as Dr Pillay put it, "the grand sum of R50000!". The Group was also the first in ML Sultan Technikon as a whole to secure outside funding. Dr Pillay described the general pattern of funding that has followed since then:

Different sources of funding would be Water Research Commission projects that we have as us as the only contractor, and we've had a couple of those, and there the funds come directly to us. There have been various projects where, in projects with Stellenbosch University for example, where we are down as collaborators. So then I get some bucks from Ed for that. I've also got smaller amounts from Chris [Buckley at the University of KwaZulu-Natal] like that. There have been some projects like the ones I've just mentioned – the Atomic Energy one, we had a project or two with Eskom which was about R150 000. So that's basically the basket of things. (Lingam Pillay, interview, 15 June 2004)

According to Dr Pillay, while there has been an increasing need for DIT as a whole to obtain funding from external sources, this has not actually translated into practice. Part of the problem is that policies relating to external funding, consultancy work and intellectual property have either not yet been formulated, or have not been implemented where they are in place.

So, the institution is saying, okay, it is a good thing to get money from outside to help our budget – there are one or two isolated groups that are getting outside funds at present – but the institution as a whole has not moved towards that yet, they're still talking about it. (Lingam Pillay, interview, 15 June 2004)

The Department of Chemical Engineering is far more 'entrepreneurial' in its approach, both out of necessity and out of a desire to prove that it can be sustainable on outside funds. The Department has adopted a specific strategy in order to make their work and their existence sustainable, namely to take the most promising technologies to the point of commercialisation.

We see the commercialisation of technologies as the route forward – the direct effect being a stream of income; but the indirect effects being more of a multiplier effect. (Lingam Pillay, interview, 15 June 2004)

This multiplier effect is specifically in building the capacity of and potentially creating employment opportunities for postgraduate students, and improving the Department's status in the eyes of potential funders.

4 Overview of the ultrafiltration capillary membrane and process development for water treatment project

4.1 Delineating and mapping the project series

Dr Ed Jacobs, project leader at the Institute for Polymer Science, described the manner in which the capillary membrane technology was developed as “evolutionary”. It started with a relatively crude membrane technology that he and others had developed; a desire to find a commercial application for it; and, according to Dr Jacobs, considerable foresight on the part of the Water Research Commission for deciding to fund the technology’s development in the first place.

Box 2: The Water Research Commission

The WRC was established in 1971 in terms of the Water Research Act (Act No 34 of 1971).

The mandate of the WRC includes:

- Promoting co-ordination, co-operation and communication in the area of water research and development
- Establishing water research needs and priorities
- Stimulating and funding water research according to priority
- Promoting effective transfer of information and technology, and
- Enhancing knowledge and capacity-building within the water sector.

Research funded by the WRC is via three funding mechanisms – solicited, non-solicited and consultancy work.

The focus areas of the WRC are organised into five Key Strategic Areas (KSAs) and a number of cross-cutting themes. The capillary ultrafiltration membrane projects fall within KSA3: Water Use and Waste Management, which focuses mainly on the domestic, commercial, industrial and mining water sectors. It aims to proactively and effectively lead and support the advancement of technology, science, management and policies relevant to water supply, waste and effluent management, for these sectors.

Source: <http://www.wrc.org.za/>

How this would be done and where it might lead were unclear and unknown. Opportunities and obstacles, and good and bad ideas, steered the individual researchers, their students and some external stakeholders onto a particular path. The account of these developments, outlined in this case study, thus represents a retrospective view, and thereby imposes a logic that was not necessarily anticipated in the first place.

From this retrospective view, the capillary ultrafiltration membrane technology evolved in two parallel ‘streams’ of R&D projects, namely, drinking water, and membrane bioreactors (biotechnology). There was considerable ‘cross-work’ between collaborators, disciplines and institutions, and numerous feedback loops between parallel projects. Each of these R&D ‘streams’ are, in turn, related to other research streams, between which there are further feedback loops and interaction.

For the purposes of this case study, appropriate ‘cut-off points’, specifically in terms of inter-related projects, collaborations or scientific objectives were sought. This was undertaken in close consultation with Dr Ed Jacobs and Dr Lingam Pillay. The result is a

selection of projects – the ‘project series’ – which contributed directly to the development of a specific technology for one of the parallel streams mentioned above, namely **Capillary ultrafiltration membrane technology and process development for the treatment of drinking water**.

Given the large number of separate projects, the non-linear project or technology trajectories, and the various people involved over time, this is quite a challenging ‘story’ to tell. For this reason, these projects at two levels are described at two levels. The first is a ‘bird’s eye view’ of a series of projects which in one way or another, directly or indirectly, contributed to the development of the capillary ultrafiltration membrane technology that is available for commercialisation today. The second is a more detailed narrative that attempts to highlight the significant developments and turning points in the project series, in terms of the research and development efforts in developing and improving the membrane technology, the various collaborations involved, as well as the intellectual property issues that emerged.

Figure 7 is an attempt to ‘map’ the projects that have, in important ways, contributed to the development of the capillary membrane technology for treating drinking water. This project series map is not self-explanatory and it should be read in conjunction with the more detailed descriptions in the following section. Instead, it serves the purposes of summarising and visually representing what is ultimately a very complex and intricate network of projects, people, institutions and events.

This ‘mapping’ exercise was by no means straightforward. In particular, intellectual property issues, and problems with memory recall on the part of the participants mean that this ‘map’ is by no mean exhaustive. In addition, the map does not necessarily reflect the formal documentation (project reports) that accompanies each project, since there are some developments, which feed into later projects, which never actually are reported on in the final project reports for the WRC. Dr Pillay explains:

The membranes that we are currently using, I think, came out in about 1999 or 2000. But once again it is difficult to put that to a specific project, because we say, okay, this is the work we need to do. You know, you’ve got a project and you’ve got an objective, but you actually add on more objectives etc. So you end up doing more things in terms of where we want to get to, rather than the specific projects. And as Ed said, when you come to write up the final report for that project, you have to look at what were those aims and then you take those bits out and put [them in the report].
(Lingam Pillay, interview, 15 June 2004)

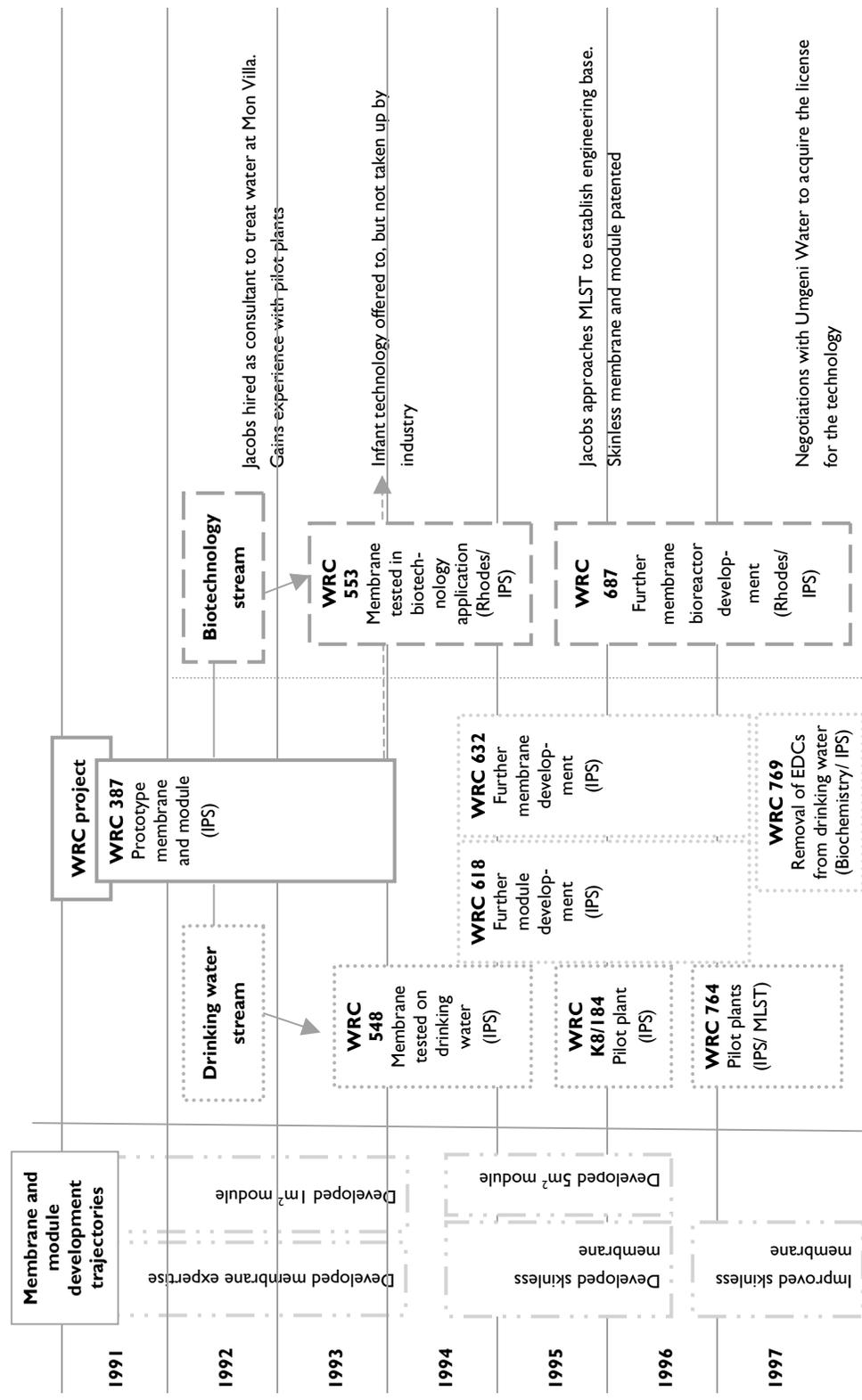
The project series map in Figure 7 highlights the following (from left to right):

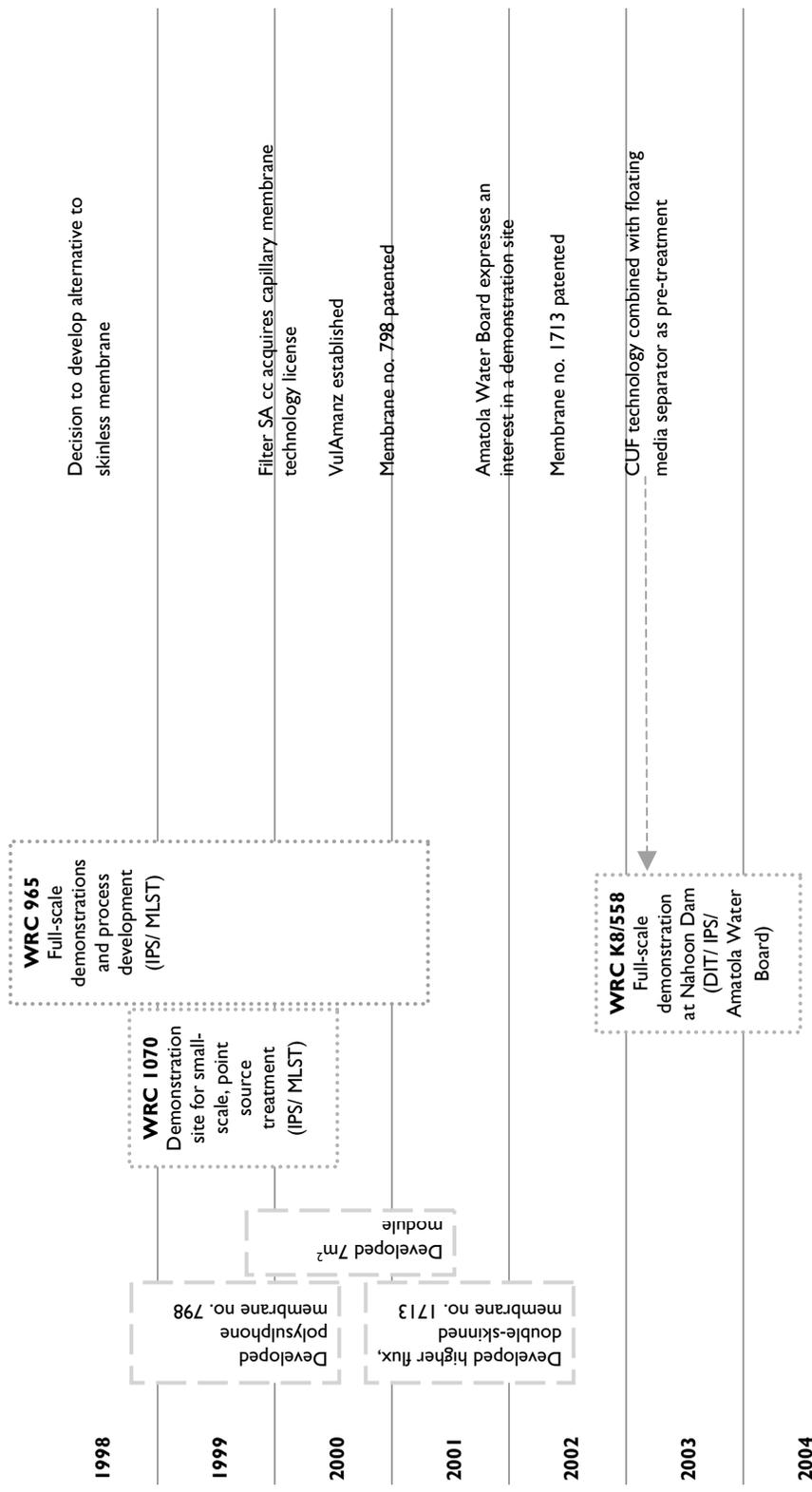
- (1) A timeline from 1991 to 2004, the duration of the project series under discussion. The timeline highlights the way in which many of the projects overlapped, and how the two R&D streams of drinking water and biotechnology ran in parallel.
- (2) The development and improvement of the membranes and modules that have resulted in the current capillary ultrafiltration membrane technology for drinking water. These developments were the result of the specific WRC projects

under discussion, as well as other projects in which the researchers and their students were involved. Readers should note that there was therefore considerable feedback between the various WRC projects and the process of membrane development.

- (3) The WRC projects in the two parallel R&D streams. Note that the project titles have been shortened and paraphrased. See Appendix I for the details each of the projects, including their objectives, which are included in the project series under discussion.
- (4) Key developments or turning points with regard to collaboration and attempts to commercialise the technology.

Figure 7: Technology trajectories and project series





4.2 Detailed description of the projects and the research process

The three 'narratives'

In the data analysis for this case study – interview transcripts, documents and reports, informal conversations, and diagrams – three distinctive but interdependent narratives emerged. The first is a 'project series narrative' which tells the 'story' of the research process within the project series – what and who was involved, what the projects aimed to achieve. More importantly, the project series narrative highlights how the projects in the project series relate to one another in the development of a technology. What emerges strongly in this narrative is what one might call the 'scientific' or 'technological journey' insofar as the primary focus is on how the research process unfolded and the extent to which the scientific or technical objectives were met. This narrative also serves to paint a picture for the reader of the substance of the projects.

The second thread in the story is the 'project team and collaboration narrative'. This narrative focuses primarily on the individual work of, and collaboration between, Dr Ed Jacobs and Dr Lingam Pillay, the two project leaders and the two protagonists of this tale. It is closely linked to the project series narrative because it was precisely the interaction between these two individuals that made the development of the technology – in the way that it developed – possible. The collaborative arrangement between Dr Jacobs and Dr Pillay, and between their respective organisations, also represents a unique approach to a 'division of labour' between a university and a technikon in the development of a technology. As such, this collaboration offers some important and creative ideas about the possible role or niche areas of universities and technikons in relation to the innovation process in the current South African context. In addition to this primary collaboration, the collaboration narrative also highlights interactions between the research groups and external stakeholders.

The third thread in the story – the 'intellectual property and commercialisation narrative', highlights the various attempts (most failed) at commercialising the technology over the years. A core feature of some of these endeavours was conflicts around intellectual property and these are highlighted.

This case study attempts to reconstruct a fairly unified version of the story as told primarily from the perspectives of Dr Ed Jacobs and Dr Lingam Pillay, but including interviews with other participants and a range of project documents and reports. It is understood that a slightly different story would have emerged if other individuals were chosen as the central characters. Nevertheless, this is a powerful story and a success story and thus, in the author's opinion, very worth the telling.

Background to the initiation of the project series (pre-1991)

The capillary ultrafiltration membrane technology, which forms the basis of the projects discussed in this case study, is based on years of prior work by Dr Ed Jacobs (project leader) and colleagues in the Institute for Polymer Science. The membrane technology that was developed in these earlier years (1970s) was taken up by a company – first in 1982 and again in 1986. Increasingly, Dr Jacobs started to think about possible applications for the membrane technology on which they had been working, and specifically for the

treatment of drinking water.³ In particular, Dr Jacobs was interested in finding a large-scale application for the capillary membrane.

At the International Congress on Membranes held in Chicago in 1990, Dr Jacobs discussed where the innovative capillary membrane technology was going, and particularly in relation to the treatment of drinking water with a French academic. It was in this context that the idea for using the membrane technology in conjunction with conventional chemical water treatments emerged. Internationally, regulations regarding the quality of treated water had become far more stringent and the thinking was that adding the membrane technology after conventional chemical treatments would help to satisfy these international standards.

Dr Jacobs' discussion with the French academic also explored the implications of developing the membrane technology in and for the South African context. For instance, Dr Jacobs recognised that it would not be as sophisticated as the European versions; that it would have to be less expensive; that it would need to be based on materials that were suited to the type of water in South Africa; and, that it would need to find a way to circumvent potentially poor monitoring practices.

What [the Europeans] saw was that you still have your conventional water treatment system, and that you hook a membrane system after it. Because plans were on the cards, at that stage, of really coming down with drinking water standards, water quality standards in Europe, and there's no way they'll tender the conventional treatment plant to meet those standards. So looking at nanofiltration membranes, microfiltration and ultrafiltration as a treatment after conventional. So the discussion then went, okay a challenge would then be to, in a situation in South Africa, where we have extremely high technical abilities in certain areas, to work on a more robust membrane. Alright, so we're not as fancy as European's flux-wise and all that, but that can take a bit of hammering, alright? And go for lesser treatment in order to save costs, and then see whether one can actually do the dead-end process with those membranes. And that's more or less, if I can recall, it was a long discussion, very friendly and lots of arguments as well because he was very pro the membrane that he was developing, which was a sort of acetate kind of membrane. I don't particularly fancy that material because you have to be careful of your control of the pH, for example, and also of the hardness of the water, and there are some limitations. I am from South Africa and I know the guys where they do the chlorine sampling at drinking water places they, you know, the guys just keep on writing 0.6, 0.6, 0.6, 0.6 and he doesn't even do the readings.

³ Dr Jacobs' concerns about unsafe drinking water, particularly in the rural areas in South Africa, first emerged when he was a young boy living in the Eastern Cape: *I grew up in the Eastern Cape and what's always bothered me were these people that would get up at four o'clock in the morning to wander down hills and go and fetch dirty water and then all the way up to the top, and drink from it, and maybe get sick because cows have been there, kids have been there ...* (Ed Jacobs, interview).

That's true, it happens. So your system that you develop in the end, the membrane process that you develop in the end, must accommodate the nightshifts and the off-day and Mondays and Fridays and the Saturdays and Sundays of water treatment facilities, and still provide a good quality [product], without the membrane losing out in the process. (Ed Jacobs, interview)

These discussions at the ICOM meeting gave Dr Jacobs much to think about and, in 1990, he made a decision to look at the development of ultrafiltration capillary membrane technology, specifically for the treatment of drinking water:

I had to make a decision. I can now make these membranes and battle, yes we can now make them, and once we've now approved them, what are we going to do with them? Where's the market going to? What is the vision of these people? What are you guys ... the Americans – where you going? The Europeans – where you going? The Australians – where you going? And everybody said well, if you want to meet the drinking water standards that are coming, you have to go ultrafiltration. (Ed Jacobs, interview)

This decision started what was to become a long and fruitful R&D journey. What unfolded in the following years was an intricate network of projects, and interdisciplinary and inter-institutional collaboration, the results of which far exceeded the original ideas and hopes of the participants.

Development of prototype capillary membrane and module technology (1991–1993)

The starting point for the 'project series' narrative was the project WRC K5/387 in which the techniques for producing a capillary membrane, and the 50mm 1m² module for housing the membrane, were developed. In technical terms, this technology included "a membrane-production technology for a medium-molecular-mass cut-off ultrafiltration poly(ether sulphone) capillary membrane, including a 50mm cartridge module to house the membranes" (Jacobs & Sanderson 1997:iii). Four patents emerged from this project, all of which were held by the Water Research Commission.

During this project, in 1992, Dr Ed Jacobs was hired as an unpaid consultant to filter fouled water at the Mon Villa seminar centre at the University of Stellenbosch. This event is significant in two ways. Firstly, Dr Jacobs was exposed to field pilot plant set-up – a stage in the process with which he was not very familiar. This experience would prove useful later down the line. Secondly, according to Dr Jacobs, this is when his collaboration with Prof Piet Swart in the Department of Biochemistry (University of Stellenbosch), around membrane technology and membrane fouling, really began to crystallise.

In 1992, Dr Lingam Pillay obtained his PhD in chemical engineering at the University of Natal. After this, he joined the Pollution Research Group at the same University as a Senior Research Fellow. The research focus of the Pollution Research Group was also on membrane technology and water treatment. At that stage, the Group was working on a technology called woven fibre microfiltration – a South African-developed technology that was aimed at drinking water. They were also working on a membrane bioreactor

configuration for wastewater treatment works. The capillary membranes that Dr Jacobs was working on, and the woven fibre microfiltration technologies, were viewed as competitive technologies. Therefore, according to Dr Pillay, although he and Dr Jacobs were acquaintances at the time, they did not really engage with one another.

Infant membrane technology offered to industry for commercialisation (1993)

Via WRC 387, Ed Jacobs and his team developed techniques for producing capillary membranes and had developed a small module to house the membranes. In 1993, this infant membrane technology was made available for commercial application. In particular, the technology was offered to a company, which is now called Weir Envig, but the company did not take up the technology. Jacobs *et al* (1999:xi) suggest that industry simply could not see the benefits: “Industry was slow to recognise the potential of the membrane system developed.” This was a heavy blow to the project team after years of work and great expectations about getting their technology to the stage of commercialisation, via the same route that had proved successful in the past.

This turned out to be a critical turning point for Dr Jacobs. Having failed to get industry to take the technology further, Dr Jacobs decided that it was up to him and his team to do so themselves. He also felt that the costs incurred in the research and development of the technologies had to be justified. Dr Jacobs and his colleagues asked themselves, if industry is not interested, then what else could you use these membranes for? Two other potential uses were identified, namely in the treatment of drinking water, and in membrane bioreactors used in treating effluent. Two WRC projects were initiated which sought to explore these options.

Testing the capillary membrane system in two potential applications (1993–1994)

Dr Jacobs and colleagues approached the Water Research Commission in 1993, this time for a consultancy project in which they could test the membrane system on real waters. The project (WRC 548) was undertaken in conjunction with the Uitenhage Municipality. The aim of the project was to see how the membrane performed in water disinfection, drinking water production, and the disinfection of secondary sewage water. Originally, the ultrafiltration and nanofiltration membranes and modules were to be tested on secondary-treated sewage as well as on Orange River water (Jacobs & Barnard 1997:ii). Ultimately, the testing only took place on surface water at Mon Villa, the seminar centre at the University of Stellenbosch, which receives its water from the Theewaterskloof / Helderberg irrigation scheme (WRC K8/184). The project team set up a laboratory bench on site, in order to run tests on the water. According to Jacobs & Barnard (1997:vi), the “results of the trials at Mon Villa demonstrated the usefulness of ultrafiltration capillary membranes as a one-step treatment option for potable water production.”

On the biotechnology side, Dr Jacobs entered into collaboration with Prof P Rose (Department of Microbiology & Biochemistry, Rhodes University) to test the membrane in membrane bioreactors on industrial effluents (WRC 553). The Rhodes partner did the microbiological and biochemical work, and Dr Jacobs supplied the membranes. The main

question was: How do the membranes perform in bio-separations, either as a filter or as a support matrix in a membrane bioreactor device? The outcome was positive.

Further development of the capillary membrane and module (1994–1996)

As projects WRC 548 and 553 got underway, Dr Jacobs and his colleagues started to receive feedback about the performance of the membranes on real waters. The team also wanted to increase the size of the module that was to house the membrane. As a result, in 1994, two new projects (WRC 618 and 632) were initiated to deal with the problems that had been identified. Project WRC 618 was undertaken in collaboration between Dr Ed Jacobs and a colleague from the Institute for Polymer Science. This project involved the further development of the axial-flow bayonet-type module conceived in WRC 387. In particular, the production techniques for a 90mm 5m² module were developed, which were then patented. A transverse flow capillary membrane module was also developed for use in membrane bioreactors. Dr Jacobs was project leader for the first year, after which he handed over leadership to his collaborator Mr Domröse. Dr Jacobs had gotten what he needed, however, namely the now larger axial-flow module for his drinking water research.

The primary aim of project WRC 632 was to further the membrane technology which was developed during project WRC 387 for the commercialisation of the micro- and ultrafiltration capillary membranes for application in three areas, namely, potable water, sea water,⁴ and industrial and secondary treated effluents. The objectives of this project are described in the final report as follows:

The main aim of the present programme is to further the production technology for capillary membranes and to extend it to materials other than poly(ether sulphone), particularly polysulphone. This was to be approached by investigating new membrane formulations and upgrading the research production facility developed during the earlier programme into a commercial production unit. This should decrease membrane handling and production costs and eventually favourably influence the economic acceptability of membrane filtration in the treatment of water intended for potable and other uses. (Jacobs & Sanderson 1997:iii)

The result of the project was the development of a skinless or unskinned membrane, which was then used in WRC 548 that was also running at the time.

Further development of the capillary membrane bioreactors (1995–1997)

In 1995, project WRC 687 was launched which involved the further development of the capillary membrane bioreactors that were developed during WRC 553. It also used the unskinned membranes that were developed during WRC 632, as well as the transverse flow modules that were developed in WRC 618. This project, investigated the gradostat concept (although it was not reported on in the project report), and the eventual outcome of this was the formation of a company called Synexa (Pty) Ltd.

⁴ The focus on seawater was never pursued since a membrane technology for the filtration of seawater was already available in South Africa.

Again, the project was a collaborative undertaking, this time between Dr Jacobs and Dr Burton from Rhodes University. The majority of the biotechnological and enzymological research was carried out in the Goldfields Biotechnology Research Centre within the Department of Biochemistry and Microbiology at Rhodes. Dr Ed Jacobs carried out the production and analysis of the membranes.

Pilot plant to test the membranes on borehole water (1995)

In 1995, the Mon Villa seminar centre at the University of Stellenbosch approached Dr Jacobs to see if he could treat and clean their borehole water, which had been polluted, for potable use. This was the first consultancy project (WRC K8/184) from the Water Research Commission. Initially, Dr Jacobs and colleagues used the 1m² membrane module that had been developed in WRC 387, in order to test whether the water could, in fact, be cleaned using the membrane. This proved to be successful and Dr Jacobs and his student Kobus Botes constructed a small pilot plant at the site. For the plant they used the 5m²-unskinned membrane developed in WRC 632 and the module developed in WRC 618. The lessons learnt about plant construction in this consultancy project would prove useful in the implementation of a later project, WRC 764.

Initiating collaboration with the ML Sultan Technikon to establish engineering base (1995)

During this time, in 1995, Dr Jacobs realised that he needed an engineering platform to take the technology further in terms of system and process development. He also realised that he needed to build capacity amongst engineering students in this particular technological area. At first, Dr Jacobs approached the Department of Chemical Engineering at the University of Stellenbosch, but no one showed any interest in the idea. Dr Jacobs then approached Dr Lingam Pillay.

And this is when I contacted ML Sultan Technikon, at that time, and I said to Lingam [Pillay], well is there any possibility that we can work together? I will motivate the project with the Water Research Commission. This looks like a real possibility of going to the industry, but I feel this is a situation where the researchers or the academics must take it further, one step further to make it more attractive for a commercial company. Not just give them a membrane, give them a membrane and a process. But I can't do that on my own, alright? The work is too applied for the guys at Stellenbosch University and there was not really anybody, any of the lecturers – at that time, let me say – who were keen on taking on extra work, other work, especially since there was no consultancy money available. Lingam then said yes, it sounds like a good idea. (Ed Jacobs, interview)

Dr Jacobs and Dr Pillay were introduced during a conference in 1992 in New South Wales. Dr Pillay was there as a postdoctoral fellow. Dr Jacobs' accommodation arrangements went awry and he approached Dr Pillay, who at the time was staying in a two bedroom flat, to ask if he could stay with him.

Dr Pillay explains how during this time he and Dr Jacobs formed a good relationship and overcame the more obvious cultural and political differences between them:

So that was the first time I got to know Ed. He was an Afrikaner from Stellenbosch University. Now at that stage I was very strongly Azapo, Black Consciousness, etc. So Ed and I had quite a few interesting discussions, as you can imagine! But now the interesting thing was that, I automatically expected Ed to defend the State. And he said, no! We've got nothing to do with it, I don't like them either! It was my first realisation that not all Afrikaners are hardcore Broederbond⁵ members, you know, that type of thing. So, Ed and I got on quite well. (Lingam Pillay, interview, 15 June 2004)

At the time that Dr Jacobs approached Dr Pillay about possible collaboration, there was very little of a research culture at most technikons in South Africa, especially those that are now regarded as 'previously disadvantaged', such as the ML Sultan Technikon. Dr Pillay explains his and his students' initial reaction to the invitation as follows:

At first my colleagues, my research students, and I, were very sceptical of whether anything substantial would develop from a liaison with Dr Jacobs, noting the very significant differences between my group and the Institute for Polymer Science, not the least of which was the geographic distance. (Jacobs et al 1999:69)

After this, Dr Jacobs presented a series of lectures on ultrafiltration and capillary membranes to Dr Pillay's students. This generated a lot of interest on the part of the students, who subsequently were very enthusiastic to take Dr Jacobs up on his offer for two of them to help design and construct capillary ultrafiltration plant units at Paarl. According to Jacobs et al (1999:69), "The units were relocated to Windhoek and Suurbraak after construction. The two remaining students were sent to Suurbraak and Windhoek and were responsible for the operation and evaluation of the units on site."

Through these early experiences, Dr Jacobs and Dr Pillay realised that there was great potential in their collaboration:

Then we realised that there was quite a bit that we could complement each other in, in terms of students from Tech being used out in the field, and students from varsity being used more in the lab type thing. A lot of field evaluation etc will not fall under the ambit of an M at a university, whereas in-service trainees could do that out here. (Lingam Pillay, interview, 15 June 2004)

Pilot plants to test the technology on drinking water (1996–1998)

The first collaborative WRC programme involving the Institute for Polymer Science and the Department of Chemical Engineering was WRC 764. The overall aim of this project was to demonstrate and further the technology that evolved during WRC K8/184. This would include "research into the development of a package capillary ultrafiltration (UF) membrane filtration unit to provide affordable, safe drinking water from sub-standard

⁵ The Broederbond is a right-wing political group in South Africa.

surface or sub-surface resources for use by rural, farming and/or otherwise deprived communities, schools and medical clinics.” (Proposal for WRC 764).

Various pilot-scale investigations were initiated during the course of the project, one each in the Southern Cape (Suurbraak near Swellendam), the Western Cape (Mon Villa near Stellenbosch), KwaZulu-Natal (Wiggins Water Works, Durban) and Windhoek in Namibia. The pilot plants were designed and built by students at the then ML Sultan Technikon. The students also received lectures presented by Dr Jacobs and Dr Pillay, as well as practical training via participation in research and development activities.

The results of these trials showed that both the ultrafiltration process and the membrane capillaries functioned well to produce potable water of an acceptable quality, although with some modifications. The project also served to establish the engineering base that Dr Jacobs required:

A sound and interactive engineering platform was established between the Institute for Polymer Science, ML Sultan Technikon and Umgeni Water during the course of the project. This will provide the necessary skills base to further the technology to its natural conclusion. (Jacobs et al 1999:xxiii)

With the involvement of Dr Pillay and students from the ML Sultan Technikon, Dr Jacobs received feedback about the membrane and module technologies. In particular, the project team discovered that the operational protocol was too harsh for the membrane. In addition, Dr Pillay and his team started to put their own proposals in to the WRC, projects that, in time, provided even further feedback. Dr Jacobs described this ‘cross-work’ between the two groups as follows:

And then the real feedback started coming – we have problems with the modules, but not because of the mechanics of the modules, certain other features of the modules. Can we modify that? Yes, fair enough, we can look at ... and the cross work started. Further to that, [] from the experience that they’d gained, they started putting forward projects to the Water Research Commission in other applications. Now each time there was another application, we got feedback into the membrane development part. If we have a problem with the membrane – not really the membrane quality or the membrane material, can you change the materials slightly? Can you make them from another material? This material is not resistant enough for the oil-water separation. The membrane’s we’ve been using for, the drinking water membranes are not compatible with some of the effluents. But the other membrane that we used to use initially, that material is [compatible]. Then we developed another membrane, packaged it into the same module that we have now, upgraded quality-wise and so on. (Ed Jacobs, interview)

Attempt to acquire the license to develop the technology further (1997)
During WRC 764, the Water Research Commission, which owned the patent for the capillary membrane technology, had decided to grant the license to develop the

technology to Umgeni Water. Dr Pillay⁶ and Dr Jacobs immediately approached the WRC to request the rights to develop the technology themselves, since whoever had the license could commercialise the technology. The WRC agreed on condition that Dr Jacobs, Dr Pillay and Umgeni Water would get together and find a collective way to take the technology forward.

We held a meeting with Umgeni Water and they decided to investigate the technology. So they actually agreed to put funding forward to build a unit out at Durban, to investigate the technology. And essentially that, the running of that rig and all the rest of it actually became part of this project. So, [WRC] 764 had evaluations in various parts of the country, and one of the evaluations was at Wiggins [Water Works in Durban] and this was on a rig that Umgeni Water had built [with the help of Technikon students]. (Lingam Pillay, interview, 15 June 2004)

Dr Jacobs and Dr Pillay continued to hold discussions with the people from Umgeni Water in order to come to some collective agreement. However, according to Dr Pillay, these discussions did not produce anything constructive:

Basically it just went round in circles. So eventually the whole thing of forming a company, or getting a license together with Umgeni sort of fell away. It wasn't disagreed; it just lost momentum. (Lingam Pillay, interview, 15 June 2004)

Nevertheless, having discouraged the WRC from giving the license away, Dr Jacobs and Dr Pillay then embarked on a new set of projects to further develop the technology.

Further membrane development for biotechnological and drinking water applications (1997–1999)

The next project to be launched was WRC 769. The primary aim of this project was to improve the capillary membrane and module technologies developed in project 632 to standards acceptable for application and commercialisation. In particular, there were a number of feedback loops between this project and WRC 764, which had started a year earlier. The project's three objectives included capillary membrane production development (development of fabrication protocols); membrane modification; and axial-flow module and manifold development. "The project started in 1997 and was extended until 2001, without additional funding, in order to meet its objectives with respect to module scale-up" (Jacobs *et al* 2003:xiii).

This project again focused on the two streams – the biotechnological stream, in which Prof Swart worked on EDC (endocrine disruptive chemicals) removal; and the drinking water stream. An important outcome was the development of a 110mm 7m² capillary membrane module, which was later used in the full-scale pilot demonstration in project WRC 965.

⁶ At the time, Dr Ed Jacobs and a colleague Mr Deon Koen were partners in a closed corporation called Filter SA. Dr Jacobs immediately made Dr Pillay a member of the company so that Dr Pillay could talk and negotiate on behalf of Filter SA.

Full-scale demonstration sites in Durban and Paradyskloof (1998–2000)

As projects WRC 764 and 769 were underway, Dr Ed Jacobs and Dr Lingam Pillay decided to draw together all the lessons learnt during these projects and run a full-scale demonstration as an industrialisation step. Two plants were constructed – one at Umgeni Water in Durban, and the other at Paradyskloof in the Western Cape. The construction of the pilot plants drew on experience gained in WRC 764, and the project evaluated the 110mm 7m² module that was developed in WRC 769. The pilot plant was eventually revamped using the 5m² module and the process was further fine-tuned.

Demonstration site for small-scale, point source treatment (1999–2000)

While WRC 965 was underway, Dr Pillay motivated a further project (WRC 1070). Essentially, this project replicated the pilot plants in WRC 965, but this time on a much smaller-scale. Known as “point source treatment”, this demonstration technology is intended for use at individual sites, such as on farms or at rural clinics. The pilot plant used the modules from WRC 769.

Filter SA acquires the capillary membrane technology license (2000)

In 2000, Dr Pillay and Dr Jacobs again approached the Water Research Commission about acquiring the license to develop the technology and this time they were successful. The license is exclusively with Filter SA, the closed corporation that is owned by Dr Ed Jacobs, Mr Deon Koen and Dr Lingam Pillay.⁷

Establishment of VulAmanz Membrane Technologies (Pty) Ltd (2001)

In 1999, the commercialisation arm of the University of Stellenbosch – UniStel Group Holdings (Pty) Ltd – was established. UniStel conducted an audit of the “intellectual property portfolio of the University as a whole” and, within the broad field of material science, identified Dr Jacobs’ capillary membranes “as one of the more exciting research areas where commercialisation might be possible” (Gerard Verhoef, interview). In 2001, UniStel approached Dr Jacobs, and he and Dr Pillay held discussions with UniStel, as well as the Rector of the University at the time, Prof Andreas van Wyk. At this meeting, the University pledged R150 000 to get the technology off the ground. Dr Jacobs and Dr Pillay each were to have a 26% share in the company – which would come to be known as VulAmanz Membrane Technologies (Pty) Ltd⁸ – with 26% of the share going to UniStel. Dr Pillay explained the original set-up:

We had a meeting with [Prof van Wyk], which actually went very very well, and they told us at the end of that that they would invest. And we had an agreement that basically said that Ed and I would have 26% of the shares each, UniStel would have 26% and they would get going with it. The Board of this company, VulAmanz, was supposed to have been Christo Viljoen, Ed Jacobs and myself. Gerhard Verhoef, who was the officer of intellectual property, was sitting in as representing the office of intellectual property.

⁷ Filter SA cc was established in 1997 by Ed Jacobs and Deon Koen in order to commercialise the membrane technology.

⁸ The name “VulAmanz” is derived from the isiZulu phrase *vula amanzi*, which means “open the tap”. The name originated during the course of one of the earlier collaborative projects between Ed and Lingam when someone asked one of the Zulu-speaking students what “open a tap” is in isiZulu.

They insisted that they would appoint the [managing director] of the company, which they did. At that stage we had already prepared various things on markets etc and everything was basically handed over to these guys. (Lingam Pillay, interview, 15 June 2004)

Box 3: UniStel Group Holdings (Pty) Ltd)

UniStel Group Holdings is a company that is wholly owned by Stellenbosch University. It was founded to exploit know-how (including intellectual property) arising out of research at the University. It provides opportunities to staff members and students of the University to commercialise intellectual property in conjunction with the Office for Intellectual Property, through a number of subsidiary and associate companies.

Source: <http://www.sun.ac.za/kiel/unistell>

When VulAmanz was established, Dr Jacobs and Dr Pillay agreed that the technology license, which was held by Filter SA cc, would now be ceded to VulAmanz. Dr Jacobs wrote a letter to the Water Research Commission to that effect. Unfortunately, this arrangement would result in considerable conflict between the parties involved and, in the end, would not really materialise into a functioning and productive company. The discussion about VulAmanz is continued in Section 6.

The Amatola Water Board expresses an interest in the technology (2002)
During this time, the project team had also been making presentations to a variety of stakeholders, including infrastructure funding agencies, local and district municipalities, and water providers, and they received a very positive response: “Particular interest had been expressed from the Eastern Cape and KwaZulu-Natal, where water providers are urgently seeking sustainable solutions to various water-associated health problems” (Proposal for WRC K8/558). In August 2002, following a workshop on small water treatment systems in Johannesburg, the Amatola Water Board expressed an interest in exploring the use of capillary membrane ultrafiltration for potable water production in the Eastern Cape province. The project team saw this as an opportunity to take the technology a step further, and for the sustainability of the system, without the involvement of the project team, to be evaluated. (Until this point, members of the project team had undertaken all the trials.)

Box 4: The Amatola Water Board

The Amatola Water Board is a State-owned, South African water utility that was established in November 1997. The organisation is mandated by government to operate as a Water Board, rendering water services to water sector institutions, to local government authorities and to other customers, as provided for in South African water services legislation.

Water abstraction, purification and bulk supply of potable water comprise the primary business activities of Amatola Water. This is supported by other, related supply services, including bulk supply of untreated water and limited retail (end-user) reticulation of potable water. Services are mainly rendered to local authorities that, in turn, reticulate the treated water to residential, industrial and other institutional end consumers in their respective communities. In addition to its bulk supply role Amatola Water offers local authorities a range of complementary services exploiting the expertise and facilities available to the utility internally or through developed partnerships with other institutions.

In 2001 Amatola Water administered some 17 water facilities (supply schemes and/or treatment works) with a combined installed water treatment capacity of in excess of 100 million litres of potable water supply per day. Despite achieving much within its short period of operation, Amatola Water faces an immense task, in conjunction with other role players, in creating access to safe water supply and basic sanitation in the Eastern Cape, particularly in many rural areas of its service area, which remain underdeveloped and lacking in financial as well as infrastructural resources.

Source: <http://www.amatolawater.co.za/>

It would be useful to pursue a little tangent to the main narrative around the development of the project series at this point, and to consider why Amatola Water was interested in the technology, where other industry players had, thus far, not taken up the opportunity to explore the technology further. Mr Johan Kilian, who was the Director of Operations at Amatola Water at the time, was present at the August workshop on small water treatment systems, and approached Dr Jacobs and Dr Pillay immediately after their presentations to discuss possible collaboration. For Mr Kilian, what made the capillary ultrafiltration membrane technology stand out against all the other presentations made over the two-day workshop, was that the technology did not require an operator to run the plant, making it more sustainable than other treatment options. Mr Kilian explained that, in his experience, using community members to work as treatment works operators was not sustainable in the long run. In particular, Mr Kilian noted that these operators, who earn a very minimal amount, were often eager to move to better paid positions using their newly acquired skills. Mr Kilian argued that this was a critical problem and could be solved with approaches that emphasise community participation:

The idea was to be sustainable, you put a system in, if you're going to go for the [approach of the] community runs it themselves and collect their own two Rands per month to pay for maintenance and things like that, the idea is that you never go back and put money back in it again. And the problem was, people put systems in, people get trained and the community takes over, or whatever, and they carry on, and a year later, or two or five years later, they have to go and rebuild the whole system because nothing's working anymore. So it was running sort of on a negative exponential scale, the longer the thing was in existence, the worse it started performing. That

time can range from a few months to a few years, that's really how bad it is sometimes, due to vandalism. The operator that they trained to run the thing realised, well, I've got skills now so why should I just sit here, and get a hundred Rand a month for this, if I can actually go and work somewhere else, a big treatment works, and get paid R10 000 or R5 000 a month. And that's a problem with those kinds of systems. That's, in my opinion, the flaw in the idea of, take the community, empower the community to actually operate their own thing, which was a big train of thought about five, six years ago, that's the flaw in it, because as soon as those basic skills are in, it's a human thing, I don't want to earn a hundred Rand if I can earn five hundred, and as soon as I can earn five hundred I move on. That's where it's better to actually have those people report to a municipality or work for a water service provider or a water service authority where they get a decent salary. (Johan Kilian, interview)

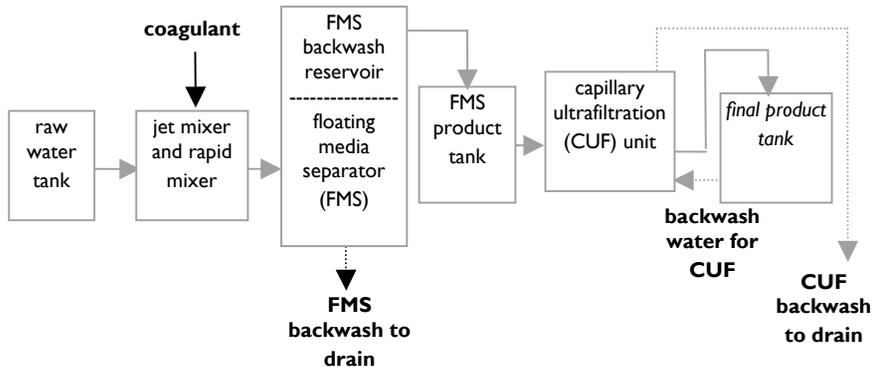
Demonstration site at Nahoon Dam in collaboration with Amatola Water (2003–2004)

The project with Amatola Water involved the construction of a demonstration site at the Nahoon Dam in East London in the Eastern Cape province. There were two contracts and projects at Nahoon. The first was a contract between Dr Ed Jacobs, Dr Lingam Pillay and Amatola Water to evaluate the system to see if it works and, more importantly, whether Amatola Water can run it under the supervision of one of their operators. Part of the agreement was that at the end of the demonstration period, Amatola would have the first right of refusal to commercialise the technology, or participate in the commercialisation. Amatola committed about R100 000 towards that project. The second project involved a consultancy project (WRC K8/558) from the Water Research Commission to help fund the exercise. The contract was between the University of Stellenbosch and the WRC.

Because of the very high turbidity (about 180ntu)⁹ of the water at Nahoon Dam, Dr Jacobs and Dr Pillay decided to install the floating media separator technology on which they had also been working, as part of the pre-treatment system in the demonstration rig. The floating media separator would serve to drop the turbidity of the water before it goes through the membranes. Originally, they had wanted to do this without any chemical pre-treatment. However, they were unable to achieve the requisite levels and eventually decided to include a chemical coagulant as part of the pre-treatment. (See Figure 8 for a diagrammatic overview of the filtration system that was installed.)

⁹ To put this figure in context, according to Dr Pillay, the average turbidity of a river in KwaZulu-Natal is about 20 to 25ntu.

Figure 8: Process diagram of FMS/CUF system at Nahoon Dam



Some problems were identified in the Amatola project, but none of these were of a kind that would result in further membrane development. Rather, they had to do with the membrane system and rig operation as a whole; in other words, they were problems associated with production scale. Examples included problems with the epoxy used on the modules (which cracked) and automatic valves that failed. All in all the demonstration was successful:

All Amatola wanted to see is, can this thing work without you guys running it? And it worked. I mean it didn't work ideally, a lot of things went wrong. But, as far as they were concerned, we have proven that the system can survive under Third World environments. (Lingam Pillay, interview, 15 June 2004)

Figure 9: The rig used at Nahoon Dam



Source: Photograph courtesy of Johan Kilian

Subsequent developments

Having proven that the system can work independently via the Amatola demonstration, the WRC projects have effectively ended and the next step is for someone to commercialise the technology. This requires production facilities for the membranes. According to Dr Pillay, the various municipalities around the country is the market with the greatest potential. Since the Amatola demonstration, Dr Jacobs and Dr Pillay have been trying to develop a market by talking about or 'advertising' the membrane technology at conferences or via direct contact with various water authorities and venture capitalists, with their ideas for commercialising the technology. As before, many of these organisations are tentative about the risks involved and continually raise questions about how much it will cost.

Dr Pillay has therefore taken it upon himself to work out what it would cost to set up a factory to produce the technology, and has developed a business plan of sorts. One of the requirements of the proposed plan is that the company will facilitate the development of small, medium and micro-enterprises. Specifically, their idea is that postgraduate students, who have worked with the technology and have the skills in the field, should be able to start up their own companies. The business plan also makes provision for 10% of the equity to be ploughed back into an educational trust, which would be used in the form of bursaries, for example, to continue to build capacity in the technological field.

There is a strong possibility that Mr Johan Kilian, Director of Operations at Amatola during the Nahoon project,¹⁰ and one of the researchers' biggest supporters, might take up the leadership of the proposed company. Currently, both Mr Kilian and Dr Pillay are trying to source capital. In June 2004, Dr Pillay sent a letter to UniStel to inform them that he and Dr Jacobs are arranging to commercialise the technology. If UniStel accepts the proposal, Dr Jacobs and Dr Pillay will resuscitate VulAmanz; if not, they will seek a partnership elsewhere, or go it on their own. Mr Verhoef of UniStel Group Holdings (Pty) Ltd seemed to agree that there is a need for a third party to take charge of the commercialisation of the technology, rather than relying on Dr Jacobs and Dr Pillay, who have full-time commitments at their respective institutions:

It still applies to the VulAmanz case, both Lingam and Ed have full-time academic commitments. They must lecture or research or whatever, and what you need is you need them to commit support to a third party. It must be an individual, an entrepreneur, whom they will trust and whom they will give their full support to run with the project. It cannot be one of them, unless one of them resigns their full-time [position]. And we've written into our intellectual property policy that unless the faculty staff member resigns, we will not support the project where there's not a full-time champion. There must be a full-time champion. I would say that if there were to be a full-time champion or entrepreneur, it would expedite matters within at least a year. [] The right team is not necessarily Pillay and Jacobs when this is a full-time commercial venture now, and I think this is the one

¹⁰ Mr Kilian left Amatola Water at the end of November 2003 and took up a position in the motor industry in East London. Mr Kilian resigned from this position at the end of July 2004, and is now in partnership with his wife in a private consultancy, Sonja Kilian & Associates cc, which is involved in labour relations and management consultancy (Johan Kilian, interview).

lesson that we are still learning is, at what stage will the two of them and UniStel say yes, our baby is a teenager now, we can let him go now. But all three parties, we must still make that decision independently. I think we're not, you know, we've spent so much time with this project that all three of us are feeling that we don't want to let it go. (Gerard Verhoef, interview)

Finally, Dr Pillay and Dr Jacobs have also been thinking about how to get the technology into the African continent, and are trying to link up with NEPAD.

5 Mode of knowledge production

The project series under discussion is complex and multi-faceted. In particular, the projects were often interdisciplinary and usually collaborative. In addition, the project series as a whole straddles the continuum from research to development to industrialisation. These features of the knowledge production context are discussed in this section.

5.1 The collaborative and interdisciplinary nature of the research

The preceding description of the evolution of the projects highlighted both the primary collaboration between Dr Jacobs and Dr Pillay, as well as collaboration with other academics and external stakeholders. Collaboration with other academics was driven primarily by the multi-disciplinary needs of the projects. Polymer Science in general is interdisciplinary in nature and frequently certain developments required the expertise from other fields.¹¹ An example of this kind of interdisciplinary collaboration was between Dr Ed Jacobs and Prof Piet Swart (Department of Microbiology & Biochemistry, University of Stellenbosch) around the development of membrane bioreactors. (See Appendix I for the list of projects and collaborators.) These types of collaborations were located in the 'basic research' part of the process. One of the most important outcomes of these collaborations were spin-offs into other research areas. According to Jacobs *et al* (1999:70), the "great success of the joint endeavours" on the capillary ultrafiltration membrane technology led to "the initiation of joint projects on membrane bioreactors, pre-treatment technologies and bio-separations."

The collaboration between the research groups at the Institute for Polymer Science and the Department of Chemical Engineering (DIT) was also interdisciplinary in nature, given that it involved a combination of Biological Sciences, Engineering Sciences, and Applied Sciences & Technologies. This broader disciplinary scope enabled the researchers to move beyond the stage of basic research to applied research and development (Stages 1 and 2 in Figure 6), and then between the two via a series of feedback loops.

At a broader level, the different roles played by each institution were reflected in the 'division of labour' between the two research groups. Both Dr Jacobs and Dr Pillay are responsible for generating ideas. The implementation of these ideas is shared, with each

¹¹ Dr Pillay and his group within the Department of Chemical Engineering did try to engage in more interdisciplinary work, that is, getting people from other disciplines involved in specific projects. They started projects with scientists from the Departments of Chemistry, and Biological Sciences. None of these projects ever got off the ground and, as Dr Pillay put it, "we back-tracked on that very quickly". (Lingam Pillay, interview, 17 June 2004)

group taking responsibility for their 'niche' area. Therefore, for example, while Dr Jacobs imparts the basic concepts and skills to Dr Pillay and his students, the Technikon group, in turn, is responsible for applying these in the field and developing them further. Similarly, while Dr Jacobs implements the ideas relating to the membrane and module production, Dr Pillay focuses on process engineering and the evaluation of these developments.

Dr Jacobs and Dr Pillay also seem to play to their individual strengths and talents in the relationship. In particular, Dr Jacobs appears to be the one with the expertise in the technology itself and the basic concepts that apply. Dr Pillay, on the other hand, leans more towards the 'people side' of the job, as well as the broader strategic thinking about which routes to follow. This was reflected in the following comment made by Dr Pillay:

Somewhere along the line, an informal agreement or whatever it is, seems to have sprung up between Ed and I that I will represent us, in terms of business interests. So, I will do the talking and Ed will do the work!
(Lingam Pillay, interview, 15 June 2004)

Having said this, both Dr Jacobs and Dr Pillay described their relationship as extending beyond specific research projects. Dr Jacobs, for example, referred to Dr Pillay (and the Department of Chemical Engineering) as a "research partner" rather than (merely) a "research collaborator". For Dr Jacobs, a research partner is much more than a collaborator because, as a partner, the people involved "share an idealism of the bigger idea" [Personal communication, Ed Jacobs, 11 June 2004]. Similarly, Dr Pillay referred to their arrangement regarding the implementation of the projects; but also to a more enduring relationship between them that goes beyond specific projects or institutional contexts:

One is the using of students from the institution, but beyond that there is a relationship between Ed and I that will exist irrespective of which institution Ed is in or I am in. (Lingam Pillay, interview, 15 June 2004)

According to Dr Pillay, much of the success of the projects and the technology has been possible owing to the collaboration between himself and Dr Jacobs. On a broader level, this collaboration served to bring in to focus a potential role for technikons in the national system of innovation. Dr Pillay described this in the final report for project WRC 764 – the first project undertaken jointly by the university and technikon groups – as follows:

[WRC 764] was the beginning of a very close partnership with the group of Dr Jacobs that goes beyond mere collaboration. The experience enabled my group to redefine its role and focus its activities. Before the above, we were not sure exactly what roles Technikons could play in research in South Africa. The above brought to light the very great need for skills in taking technologies from the laboratory and turning them into systems in the field – that is, process and systems development. Technikons are ideally suited to provide these skills, in view of the strong focus on applied technology. (Jacobs et al 1999:69)

A third important spin-off of these projects was capacity building and the establishment of an engineering base in capillary ultrafiltration membrane technology. In addition, the

collaborative projects led to a rapid increase in the number of students interested in pursuing research activities in this technological area.

In summary, the ultrafiltration projects were highly collaborative in nature, and straddled a range of disciplinary areas, including the Applied Sciences & Technologies, the Biological Sciences, Engineering Sciences, and Material Sciences, on the one hand, and Environmental Sciences and the Health Sciences (given the potential health implications), on the other.

5.2 The research, development and industrialisation continuum

The project series which led to the ultrafiltration capillary membrane and module system that we see today, together cover the entire innovation spectrum – from basic research, to process and systems engineering (development) and industrialisation. Please refer to Figure 6 (Section 3.2) where these three phases are depicted as Stages 1, 2 and 3.

For Dr Ed Jacobs, ‘basic’ research refers to discovering how and why something does what it does, while ‘applied’ research refers specifically to process development. (Note that Dr Jacobs’ definitions reflect Stages 1 and 2 in Figure 6.) In this sense, ‘basic’ research is akin to ‘blue sky’ research, or the *Frascati Manual* (OECD 2002) category of ‘experimental development’.

Basic research is: I have to develop a better this, that and the other thing, so I do a bit of basic research, so that I can find out the “whys” and the “hows”, the understandings, and then put that knowledge to use on the applied part, where you now actually build a device to do the process. (Ed Jacobs, interview)

Dr Jacobs argued that basic or ‘blue sky’ research must be coupled with applied research for it to be of any real value, that is, beyond its scientific and academic value:

If your basic research is not coupled with another person who’s doing applied research on that thing, it’s of no concern. It’s of scientific concern to find a new isotope of an element. Great, wonderful, maybe you win the Nobel Prize. But, for me as an engineer, what can I do with that knowledge? It doesn’t even affect the molecular weight of those elements so significantly that I will buy a new periodic table for these things. So what does it mean to you? (Ed Jacobs, interview)

An example is the basic concepts that emerge from fields such as biochemistry. According to Dr Jacobs, these need an engineering base to turn the concept into a technology and a process, and this is where the technikon sector can play a role. We saw this orientation clearly in the narrative of the project series that described Dr Jacobs’ early preoccupation with finding a commercial application for the membrane technology. Indeed, the notion that basic research needs to be coupled with applied research or development was the underlying rationale for the collaboration between the Institute for Polymer Science and the Department of Chemical Engineering (DIT), where each institution had its own niche. This orientation also echoes Ron Sanderson’s comments in Section 3.1 that while the majority of work that is done in the Institute is defined as basic research, this is always undertaken in close consultation with the relevant industry.

What is also interesting about this case is that through their strong desire to see the capillary ultrafiltration technology through to commercialisation, the project leaders crossed their normal boundaries. In particular, as the ‘champions’ of the technology, Dr Jacobs and Dr Pillay have taken it upon themselves to work out what it would cost to move the technology to the production scale; in other words, to take the technology to the phase of industrialisation (Stage 3 in Figure 6). They are also trying to develop a market for their membrane technology.

Once [the basic concept] gets to the proven process stage, either it's actually been discarded because it's too expensive or it doesn't really work, or it's come through and you say, hang on a second, this system now actually works, it's been proven. At this stage, the probability that an industry will take it up is far greater. Now specifically on the capillaries even [the second stage] was not sufficient, because at this stage we basically went out to industries and went out to potential investors. But because the technology was so new to the water field etc, they were just not interested in it at all. Not not interested. Oh it sounds very good, but I mean, we are not really sure – is there a market? What is it really going to cost? Who's going to sell it? So then Ed and I have actually gone partially into this third stage, where we've actually proven the thing in the field, under someone else's operation [Amatola Water]. I've had to draw up effectively almost a complete business plan where I did the costings of, this is what it actually costs to set up a production facility, these are the people you require to do it, these are potential sales, etc etc, and only when I put that document together – which is about two weeks ago – and sent that out, now I'm starting to get people saying, hey well, hang on a second, can we do something together? (Lingam Pillay, interview, 15 June 2004)

Largely, Dr Jacobs and Dr Pillay have been compelled to take these steps because the local water industry has been reticent about taking the risk on a new technology for which there is no proven market. The problems associated with uptake by industry are discussed in Section 6 below. In short, it seems that, especially in those fields where the associated industries are under-developed, that it becomes necessary at times for researchers to be pioneers, champions of their own cause, in order to prove the worth of the technology. This may mean – as was the case with Dr Ed Jacobs and Dr Lingam Pillay – that the researchers have to go beyond the usual institutional or disciplinary boundaries and to venture out into unknown territories (such as scaling-up the technology and developing business plans). In this specific case, the effectiveness of the membrane technology had been adequately proven in other countries, but it took a considerable length of time for this to trickle through into the South African water industry, and even longer for it to be accepted and taken up. Dr Pillay used the analogy of the South African government's stance on HIV/AIDS and anti-retroviral drugs, and the persistent cries of the Treatment Action Campaign for government rollout of this treatment, to illustrate this point.

5.3 Research outputs and dissemination strategies

Thus far, the discussion has focused primarily on the major output of the research project series, namely the capillary ultrafiltration membrane technology and process. Directly associated with this technology are the contract reports for each WRC project. In

addition, six patents relating to the drinking water technology have been obtained (see Appendix 2).

The project leaders have also generated a range of more traditional academic outputs in the form of articles in refereed scientific journals, chapters in books and published conference proceedings (see Appendix 3), which were used primarily to disseminate the findings to academic colleagues in a range of disciplines. In addition to the dissemination of the research via national and international conferences and meetings, the researchers have communicated their findings to interested parties in the water industry in South Africa via presentations and informal meetings and consultations with potential users. In some instances, Dr Jacobs and Dr Pillay engaged in building the capacity of users; in particular, the Amatola Water operators of the water treatment rig at the demonstration site at Nahoon Dam.

6 Mode of knowledge utilisation

The explicit model of knowledge utilisation in this case is technology transfer from basic concepts, through interactive stages of research and process development (lab-scale and pilot plant, respectively), through to production-scale technology and industrialisation. Within this broader process, technology and knowledge transfer took place between colleagues and disciplines working within particular stages of the process. In these cases, the uptake and application of previous (or parallel) research endeavours was largely successful. Despite many attempts, the efforts of the project team to commercialise the technology themselves, or to get industry to take up the technology, have been largely unsuccessful. This section considers these features of the context of knowledge utilisation.

6.1 The establishment of companies to commercialise the technology

Six patents have emerged during the project series and there have been various attempts to commercialise the membrane technology over the past decade or so, some efforts more successful than others. In one instance, a pharmaceutical company was established, based on the further development work done on the membrane for a specific pharmaceutical application. This company has nothing to do with the research groups, except that Dr Ed Jacobs (via the Institute for Polymer Science) continues to supply this company with membranes on an ad hoc basis.

A more significant attempt to commercialise the low-pressure membrane filtration technology, for drinking water in particular, was the establishment of the company VulAmanz Membrane Technologies (Pty) Ltd in 2001, which was described in brief in Section 4.2 above. VulAmanz was formed based on a co-operative agreement between Dr Jacobs and Dr Pillay on the one hand, and UniStel Group Holdings (Pty) Ltd, the commercialisation arm of the University of Stellenbosch, on the other.

As indicated earlier, despite having in place a basic arrangement and organisational structure, VulAmanz never really took off. It appears that the two parties had very different agendas and visions for the company, which led to ongoing conflict around how to commercialise the membrane technology. For Dr Jacobs, the main problem was that UniStel was too focused on exploiting home-grown technologies in order to make money, and that they did not appreciate or listen to what the academics had to say. Dr Pillay, on

the other hand, suggested that the people at UniStel with whom they were involved were simply not equipped to deal with the business side of the initiative:

My understanding was that really, none of the people who were involved in it, actually were business people. There have been other companies which have been quite successful that were under the UniStel stable. But they had nothing to do with it; it was other people, it was the entrepreneurs, and they just had a shareholding, whereas this was the first company that they were trying to run. (Lingam Pillay, interview, 15 June 2004)

For instance, Dr Pillay reported that after about the first year of VulAmanz being up and running, there was still no real marketing of the company; neither was there a strategic plan which outlined how to move the technology forward. Another concern had to do with UniStel's plan to give the technology to people in Libya with whom they had been dealing. For Dr Pillay and Dr Jacobs, this idea was economically flawed, in part because there was no discussion about what would happen to the intellectual property rights. In addition, key factors had not been taken into account in the budgeting, such as the cost for building the facilities to train the Libyans in South Africa, as well as running expenses like electricity, water and rent. According to Dr Pillay, any attempts to raise these concerns merely resulted in further conflict between them and UniStel. Eventually, the situation even started to take its toll on Dr Pillay and Dr Jacobs' relationship.

Dr Jacobs and Dr Pillay then received a letter from the Intellectual Property Office at the University of Stellenbosch, which stated that since they were unable to resolve the matter together, that the University would go forward, on its own, to market the technology. There was nothing that Dr Pillay and Dr Jacobs could do, given that they had ceded the license to VulAmanz, in which the University had a stake. However, there was a twist to the tale. As it turns out, the letter that Dr Jacobs had written to the Water Research Commission, giving permission for the technology license to be ceded to VulAmanz, had gotten 'lost' on somebody's desk. As a result, Dr Jacobs only received the documents that he had to sign after the University had sent the letter stating that they would market the technology on their own. At the end this meant that Dr Jacobs did not sign the documents and the license thus remains with them.

Problems with the uptake by industry

The description of the project series also highlighted a number of occasions when the membrane technology was offered to industry for the purposes of commercialisation. The narrative also showed that these efforts were largely unsuccessful, a state of affairs which compelled Dr Jacobs and Dr Pillay to cross over to the stage of industrialisation in order to make the technology more attractive to industry. Dr Pillay emphasised that the need to do this, to go this far, is not necessarily the case in all technological fields, and that it was particularly the case within the water industry. He explained that the water industry is an old industry, and that internationally it is conservative and slow to change. This is mainly because the industry has made huge investments in large infrastructure and are, therefore, reluctant to change to new ways too quickly.

Dr Pillay used the analogy of the telecommunications industry to highlight the unique circumstances of the water industry in South Africa.

Cell phones were complementary to Telkom, because Telkom couldn't reach everywhere, and so cell phones are complementary. Introducing membranes is actually antagonistic to conventional water treatment. Now, the water industry is very conservative. There's massive amounts of money that are invested in large infrastructure for water provision, all based on conventional water treatment models. And we're now pitching up with this new thing, which even many universities don't teach at present, and which 95% of the engineers out in the field have never heard of. (Lingam Pillay, interview, 15 June 2004)

Box 5: What kinds of industry are likely to use membrane technology?

As we have seen, local municipalities or Water Boards, which are charged with providing water services to local communities are a potential market, given their need to treat their water supplies. Mr Kilian provided examples of other industries, which use membrane technology: *There are some industries that need high quality water. If you look at the Eskoms or those kinds of people, or anywhere where you've got big boilers, for either process steam or manufacturing, or whatever they do. A boiler basically wants what you call demineralised water, you want a high quality, something that hasn't got salts and things in it so that you don't get calcification inside the boiler tubes and so on. Now those guys have got various types of systems to actually give them [demineralised] water or as good a quality clean pure water they can get. That can range from super-duper almost distilling kind of equipment to reverse osmosis on either side. Then you get people who don't need [demineralised] water but they need consistently good quality water, like the Coke factories, the breweries, could be textile, it could be a paint manufacturer that manufactures water-based paints and things like that. They want to know, the water that comes out into my process is consistently this colour, this type, otherwise my colours change, the conditions change, or whatever. So all those places have got some form of membrane technology as a filter, because membranes are basically the best fine filters. (Johan Kilian, interview)*

Mr Johan Kilian argued that the consulting engineers and contractors are also often resistant to the membrane technology because it usually means that they will earn less money, since it is easier and cheaper to install:

If you look at the project as a whole, in most instances a municipality or the Department of Water Affairs need to provide the water services somewhere. If it's a new scheme or something like that they will say, we need a scheme of two megalitres a day, five or ten or a hundred or whatever size, and 99% of the time they say, give us a scheme that can give that kind of water volume per day to the people in these villages. And they'll have a sketch and they'll say, I want the treatment works there, it must feed that village, that village and that village, boom. And then the guys go and tender for that. But the consulting engineers come back with proposals with a detailed design to design and supply a treatment works which then gets approved. Design the pipe networks and everything, price everything. And the next phase is they probably go out and tender for construction. Now if you look at how that consulting works, if you build a conventional treatment works there's a lot of excavating, there's a lot of concrete work, it's a long period. So normally these guys get paid a percentage of the project fee and then sometimes,

depending on how the thing goes, there's consulting fees for project management, for things attached to it. If you just look at that, if these guys have a choice between [either] putting a building up, level the site and put a building up, put in the pump station, [or] you start putting these modules in, you just pack them in, because they come like shelving, you just bolt them in and connect them up, it takes about a month to do that. Or you go and you excavate and you build this thing and it takes about a year and a half, there's a resistance from those guys to a certain extent, not all of them, because it could affect the amount of income they can make. The pipeline will take you the same amount of time to put in the ground, but the treatment works will go quicker. (Johan Kilian, interview)

At the same time, for about the past decade, there have been strong moves towards the development of capillary membrane technology in countries such as Japan and in Europe and North America. By contrast, the technology is relatively new in South Africa and is still regarded by many as being “too hi-tech to handle”. For Dr Pillay, the challenge is to prove to industry that the technology is both hi-tech, in terms of the sophistication of the technological concepts, and low-tech (or “smart-tech”) in terms of being relatively low-maintenance and low-cost. Again, Dr Pillay used the cell phone analogy to make his point:

The cell phone's hi-tech, extremely hi-tech – your cell phone's more powerful than most computers. But, the average person down the road, who may not even be able to speak English, can run a cell phone. It's that sort of thing. 'Smart' hi-tech as opposed to 'hi-tech' hi-tech. (Lingam Pillay, interview, 15 June 2004)

Dr Pillay concluded that for researchers to cross over to the stage of industrialisation is dangerous and not necessarily to be advocated, simply because it is an enormous risk.

What about the end-users?

Mr Gerard Verhoef, Managing Director of UniStel Group Holdings (Pty) Ltd, pointed to a problem that is relatively unique to a technology that is intended to treat drinking water, namely that the intended end-user or beneficiary – in this case, the rural poor in South Africa and potentially in other African countries – are unable to afford to pay for the technology:

The issue is that, yes, everybody knows that especially in Africa, water and more specifically potable water is a scarce resource and there's a huge market for that. That's common knowledge. The problem however is that the people who are going to consume the water cannot afford it. So there is a discrepancy that the client, the consumer and the person who is going to pay for the water is not the same person. I think that is the lesson that I've learnt from VulAmanz as a specific technology, that the moment that your end-user cannot pay for the technology you must find a third party to pay for it, because this is in essence what's happening here. We need to give potable water for 9 million people in South Africa alone, but none of those 9 million people can afford to buy potable water, it's as simple as that. You must give it to them for free. In order to give them water for free, you need to either speak to government or to [non-governmental organisations] or go

to the international funding agencies and so forth and that's a big challenge. I mean solving someone's problem and asking a third party to pay for it ... [laughs]. [] You must first ask the question, do you want to make money, or do you want to benefit society? And if you want to say yes to both, it's almost impossible to commercialise this potable water [technology]. [] Supplying potable water to non-paying customers, that's not a commercial issue anymore, that's a social awareness issue. And I think we try to balance the two, by saying yes, we can use first world technology solving a real problem, and making money out of it. (Gerard Verhoef, interview)

6.2 Knowledge transfer through capacity building and dissemination

Another important form of utilisation was knowledge transfer to postgraduate students, other academic colleagues and real or potential users. The results of the various research projects and information about the technology itself have been disseminated to a wide range of stakeholders in a number of different ways. These were described in section 5.3 above.

Both Dr Ed Jacobs and Dr Lingam Pillay place a great emphasis on building the capacity of postgraduate students. They reported that membrane products emanating from the research were used by a number of postgraduate students towards their higher degrees, apart from students that were actively involved in the development of those products themselves. A total of 12 Masters students and 4 Doctoral students will receive their degrees through work on the project. For Dr Pillay, however, capacity building should be much broader than postgraduate training and should involve providing students with opportunities to acquire greater exposure and experience in a variety of settings. Dr Pillay gave the example of the journey that one of his students has been on, because of being involved in the projects:

One of my first in-service trainees was a guy called Vincent Ndinisa. He couldn't say "Boo!" to a mouse when he joined us. Ed sent him to Swellendam. Now keep in mind that Vincent is a black guy from KwaZulu-Natal who had never been out of Durban gets sent to Swellendam Afrikaner country. From there he was sent to a project in Namibia and he had to work out there on his own, etc etc. Subsequent to that Vincent actually joined us as a Junior Lecturer. Three years ago – he started a Masters with me but then he had the opportunity to go down to New South Wales at the UNESCO Membrane Centre and he started a Masters. Last year his Masters was upgraded to a PhD. He's now back in the Department [of Chemical Engineering]. He will be finishing off his stuff here and still be registered down there. So he started off as an in-service trainee, he's come up through the ranks, been out in the field. He has chosen to go and do research because he can earn a lot more outside. Now that's, in my opinion, what proper capacity building is. (Lingam Pillay, interview, 15 June 2004)

The project leaders' vision is to equip these students with skills that will enable them to find employment in the water or related industries, or to start their own businesses. A number of these postgraduate students have, in fact, moved into industry, or have continued to conduct research in the membrane field – both important forms of

knowledge utilisation. Students who now work for membrane companies include: Mr Moodley (MTech, DIT), Mr Kobus Botes (MEng, University of Stellenbosch) and Dr Andre Maartens (PhD, University of Stellenbosch). Ms Anel van der Walt (Masters, University of Stellenbosch) now works in medical research on artificial arteries at Groote Schuur Hospital, which is related to her earlier membrane research work, and Dr Linkov (PhD, University of Stellenbosch) is conducting membrane research in his position at the University of the Western Cape.

6.3 The generation of new research areas

The process of knowledge production associated with the project series also served to generate new areas of research – both within the fields of polymer science and chemical engineering, but also in other disciplines where there was collaboration. As Dr Jacobs put it, the research branched into disciplines other than chemical engineering as a matter of both necessity and curiosity. Examples include biochemistry (enzymatic cleaning of membranes, affinity separation) and microbiology (membrane bioreactors).

6.4 ‘Scientific’ versus ‘user-defined’ measures of success

Dr Pillay made an interesting comment about scientific versus users’ requirements and measures of ‘success’, and how these might differ. He referred specifically to the project with Amatola Water. In this demonstration, the membrane system did not quite achieve the quality of water that Dr Jacobs and Dr Pillay had hoped, primarily because the turbidity of the water at Nahoon Dam was extremely high. In this sense, their ‘technical objectives’ had not been met. However, Amatola were quite happy with the results since they were still an improvement on what they had achieved with the conventional water treatment system that was in place. Dr Pillay described this as follows:

In ultrafiltration, one would expect that to give us a water of about 0.2ntu as being worse case, you know, that sort of thing. Now the type of water that we were using down at Nahoon, we had never dealt with that before. It’s really bad stuff compared to any other water that we’ve dealt with. We’ve been getting turbidities of 0.3 and 0.4 coming out. Now, from a technical perspective, Ed says now hang on a second, these membranes are stuffed. Deon is doing something wrong. It’s unacceptable, you know, the scientific community will laugh at us! From my point of view, I was in full agreement with him. And then we took another approach and said, well what does Amatola think? Now Amatola says, if anything is below 1, it’s perfectly acceptable to them. The fact that you’re getting 0.3 to 0.4 consistently, they’re over the moon about it. So, do you say the project is not working because we’re not getting what we think we should be getting from a scientific perspective, or do you say it is working extremely well because the user is over the moon and it has consistently been achieved? [] Those three stages that we were talking about, up to the end of Stage 2 which is like processing the entire thing, probably the definition of success up to that point is technically it must meet certain requirements, and economically it must look viable. When it goes into the next stage and you’re actually trying to sell the thing, then the definition of what success is probably changes quite significantly, because then, how does the user perceive it becomes the major thing. (Lingam Pillay, interview, 15 June 2004)

6.5 On ‘champions’ and flexible funding mechanisms

It is very clear that Dr Ed Jacobs and Dr Lingam Pillay have been real ‘champions’ of the capillary ultrafiltration membrane technology. Despite numerous setbacks and obstacles, they have both soldiered on, never losing their faith in the potential of the technology or their vision and passion for its commercialisation and wider application. Being the champions of this technology has also meant that both these researchers have had to go way beyond their normal boundaries, venturing out into the non-academic world of risk analysis, business plans, factories and marketing.

During the interviews, Dr Pillay observed about the current approach and structure of the National Research Foundation funding that is aimed at promoting collaboration and partnerships around technological development. The following quote highlights some of Dr Pillay’s ideas about how the NRF could re-focus their funding in terms of the important role of champions, of succession planning, and funding for partnerships between higher education institutions, or between higher education institutions and industry:

This whole concept of, you need a champion and that research doesn’t come about because a person has got a PhD, that is something that has not sunk into NRF yet. Their assumption is, take a whole lot of people, if they’ve got PhDs they will start producing, which is complete nonsense. The major problem that I have had with the NRF – by the way, the NRF has treated me extremely well – the major argument that they’ve had with me over the past five years is, hang on a second, there are no other people in your department that can take over your projects. Okay, I could turn around and say, well no-one can, because then it sounds arrogant. But that’s the reality! [] Irrespective of how well established an institution is, you might have a team of about three leaders, but if one guy goes you’ve still got a problem.¹² So, this concept of ‘no-one is indispensable’ does not apply. It’s the passion that makes the difference, rather than whether you’ve got the degree or not. [] [The NRF] keeps talking of succession planning, you must always have that, which I agree with completely. But it must be needs-based. It’s that type of thing. And when they start forcing people together. The NRF has made many attempts to get the sort of thing going that Ed and I have. They always say, hey you’re doing this, there’s a guy at university who’s doing this and you guys must work together. And you give this person money to go and visit him and vice versa, etc and it doesn’t work. Because one, in my opinion, academics by nature, if you tell him [sic] you’ve got to do this, then the person’s not going to do it. Secondly, if the chemistry isn’t there and it’s not needs-driven; it has to be needs-driven. They must realise that. [] The major problem, I think, is not so much what the NRF’s intentions are, but in translating it into practice. Essentially, they have this plan, which they then

¹² This issue goes to the heart of the tacit knowledge that individual scientists and engineers hold and the difficulties associated with trying to transfer it. It seems that each ‘champion’ has his or her own talents, skills and experience, without which a project will not be able to continue without a hitch, if she or he had to leave.

hand over to the institution to translate into practice. Now if the institution has people who are capable of translating that into practice, it will probably work, and I have no doubt that various institutions have that. I hear very good reports of Pretoria Tech; I hear very good reports about Vaal Triangle [Technikon]; where, seemingly, the person who has been charged with the task of implementing that, knows what they're on about and how to go about it. (Lingam Pillay, interview, 15 June 2004)

By contrast, Dr Pillay feels that the ML Sultan and now DIT management are too inexperienced and do not have the requisite skills and experience necessary for the potential offered by NRF support to be realised.

It gets communicated pretty well up to the institution hierarchy, and then in the implementation side of it, it falls apart. (Lingam Pillay, interview, 15 June 2004)

Dr Pillay suggested that one way to get around this would be if the NRF introduced a more flexible financial support mechanism for individuals or groups – rather than the institution – through which they could apply directly for funding for something like a smaller-scale ‘technology station’ in a specific field.

If that is extended to a lower level, when I say lower level – not everyone wants to set up a technology station. But maybe one wants to facilitate something between Stellenbosch and ML [Sultan Technikon], or whatever it is. I should be able to come up with effectively a plan for a mini technology station, around a specific area, which has a finite lifetime. [] The technology station is good for all the big research that's going on. Then we need to start having something smaller. That sort of thing, which leaves the driver as the people who want to do it, while still within the institutional context; versus expecting the institution's administrators to drive it. (Lingam Pillay, interview, 15 June 2004)

A possible home for such a funding mechanism could be the Innovation Fund, run along the lines of the Department of Trade & Industry's SPII programme, but with a specific focus on the kinds of technology development that collaborations such as Dr Pillay and Dr Jacobs have. That is, for those researchers who do not have a specific industrial partner (as is the case in the water industry).

Finally, the idea of ‘champions’ does not only apply to the knowledge producers, but also to individuals within stakeholder organisations. In this particular case, Dr Jacobs and Dr Pillay's efforts in building support and capacity within Amatola Water were thwarted when two of the ‘champions’ resigned in 2003, including the Process Director and the Chief Executive Officer. According to Dr Pillay, they are effectively “back to square one” in terms of Amatola's commitment to and involvement in commercialising the technology, because there is no longer anyone who knows about the membrane technology.

This section concludes with a quote from one of the interviews with Dr Pillay, in which he had been speaking of the range of obstacles and problems with which the researchers had

to deal. The quote illustrates the power of a positive outlook on life – perhaps one of the key attributes of a real ‘champion’ – in the winding road that is technology development:

I don't know whether all that I've just said is a negative or a positive thing! Let me just explain. Let's assume that everything was smooth, you know. I don't know whether there would have been this, I'm not explaining it too well. Okay, let's assume there was good apparatus out here, there was good support, etc etc, I don't really know whether one would have developed the same degree of passion to make something work, as in a situation where no-ones listening to you, and you say, okay, I could keep arguing with this lot, or I could say, stuff them, you know, you're a crusader now, I'm going to make this work. [] So I don't know whether the negative aspects were positive from the point of view of productivity. (Lingam Pillay, interview, 15 June 2004)

7 Concluding observations and lessons learnt from this case

This case study has highlighted some of the key features of the process of developing and improving a technology, from the original laboratory work, through to field trials and industrialisation, as well as some of the challenges associated with the commercialisation of the final product. Firstly, we have seen that the ‘technological trajectory’ of the development of capillary ultrafiltration membrane technology for drinking water involved a number of different projects, many of which ran in parallel, and between which there were many linkages and feedback loops. This was clearly evident in the constant movement between basic research on the development or improvement of the membranes and modules themselves, the engineering work to develop and refine the process or system within which the technology is employed, and the field trials in which these R&D efforts were tested. The project series that ensued between 1991 and 2004 was unanticipated, in that each project was initiated as and when the need arose for a new area of research or to test the membranes and modules in the field. In this sense, the projects, and the knowledge and technology products that were generated, were accumulative.

Secondly, the development of this technology involved ongoing collaboration – between Dr Jacobs and colleagues at the University of Stellenbosch and other institutions (such as Rhodes University) around the basic research work in the two R&D streams (i.e. drinking water and membrane bioreactors); between Dr Jacobs and Dr Pillay and his students from the Durban Institute of Technology in developing the engineering base for the further development of the technology; and between the project leaders and the Amatola Water Board in the construction of the demonstration site at the Nahoon Dam in East London, in order to test the performance of the system without the involvement of the project team. The case study has illustrated that collaboration across disciplinary and institutional boundaries can yield rich rewards in terms of the development of a technology. It has also highlighted a potential niche area for universities and technikons in South Africa in the broader process of innovation; namely, the development and improvement of technology products through basic research within the university context, and the development of an engineering base and the technology process within the technikon context.

Despite the apparent success of the primary collaboration, and of the development of an effective capillary ultrafiltration membrane technology for the treatment of drinking

water, after years of effort, negotiations and networking on the part of the project leaders, the technology has still not been commercialised. The project leaders have argued that, in part, this is because the process is too sophisticated and unknown for industry. In addition, the researchers and Mr Johan Kilian observed that industry could be resistant to technological change, especially where it involves a re-investment in infrastructure. The involvement of UniStel Group Holdings (Pty) Ltd in further attempts to commercialise the technology – this time by the project leaders themselves – has also not borne positive results. Conflicting ideas and visions for the commercialisation of the technology, on the part of both parties, means that the company established – VulAmanz Technologies (Pty) Ltd – is nothing more than a structure.

In short, both people and structures were picked up along the way, which either presented opportunities or limitations to the project series. One of the first opportunities was the financial backing provided by the Water Research Commission who, according to Dr Jacobs, showed tremendous foresight in agreeing to fund the development of a relatively unknown technology. One of the first major obstacles was the lack of interest, on the part of industry, in commercialising the technology. Dr Jacobs, however, turned this into a positive by becoming determined to commercialise the technology himself. The next opportunity was the collaboration with Dr Pillay, someone who shared Dr Jacobs' passion and vision for the further development of the technology. Although the partnership with UniStel Group Holdings (Pty) Ltd appeared to present an opportunity to the researchers, in the end it only served to create conflict and slow down the progress towards commercialisation. The budding collaboration with Johan Kilian, who is also very passionate about the potential for the technology, might well present yet another opportunity for the project leaders to reach their goals.

In summary, this case study has highlighted the precarious nature of partnerships and structures, and the importance of 'champions' – with vision, determination and passion – in order to ensure the sustainability of the whole endeavour. The case has also pointed to some of the challenges facing researchers within higher education institutions who are involved in technological development. In particular, we have seen the lengths to which the researchers will go, if they want to see their R&D efforts through to the stages of industrialisation and commercialisation, especially where the relevant industries are unwilling or unable to run with the technology. This is not an easy route, not least because of the full-time workload associated with an academic position.

In conclusion, the capillary ultrafiltration membrane technology has the potential to make an important contribution to one of the key national priorities, namely, the provision of clean, safe drinking water to poor rural communities, given that it produces a good quality water, and that it avoids many of the problems associated with the operation and maintenance of water treatment works in rural areas. One of the key obstacles, however, is money: the rural poor are unable to afford the cost of water, let alone its treatment; and it has proven a great challenge to the project leaders to find the right partner who can subsidise this financial burden.

Data sources

Face-to face interviews

Dr Ed Jacobs (Project leader, Institute for Polymer Science, University of Stellenbosch), 26 February 2004

Dr Lingam Pillay (Project leader, Department of Chemical Engineering, Durban Institute of Technology), 15 and 17 June 2004

Professor Ron Sanderson (Director: Institute for Polymer Science), 18 May 2004 (conducted by Tracy Bailey); 7 September 2000 (conducted by Enver Ravat)

Dr Jacobs and Dr Pillay: Feedback from their review of the draft case study, 13 August 2004

Telephonic interviews

Mr Johan Kilian (ex-Director of Operations: Amatola Water Board), 13 August 2004

Mr Gerard Verhoef (Managing Director: UniStel Technologies (Pty) Ltd), 16 August 2004

Email responses to additional questions

Dr Ed Jacobs, 29 and 30 July 2004; 18 August 2004

Questionnaire

'Public sector R&D in South Africa: The production and utilisation of research' questionnaire completed by Ed Jacobs, 2003

Publications and documents

Burton SG, Boshoff A, Edwards W, Jacobs EP, Leukes WD, Rose PD, Russell AK, Russell IM & Ryan D (1998) *Membrane-based biotechnological systems for the treatment of organic pollutants*. WRC Report No 687/1/98. Water Research Commission

Domröse SE, Sanderson RD & Jacobs EP (1998) *Development of specialised cross- and transverse-flow capillary-membrane modules*. WRC Report No 618/1/98. Water Research Commission

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Jacobs EP, Pillay VL, Botes JP, Bradshaw SM, Pryor M & Swart P (2002) *Ultrafiltration capillary membrane process development for drinking water*. WRC Project K5/965. Final Report to the Water Research Commission

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Jacobs EP, Sanderson RD, Oliver DM, Domröse SE & Koen DJ (1993) *The development and production of membrane systems*. WRC Report No K5/387. Water Research Commission

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WRC Report No 769/1/03. Water Research Commission
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<http://www.dwaf.gov.za/Communications/Articles/>
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Paris: OECD
- Pillay L (2004) *Report on FMS/CUF evaluation at Nahoon Dam: October 2003 to March 2004.*
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Appendix 1: Project titles and objectives

WRC project	Report title	Project timeframe	Project leaders & collaborators	Project objectives
WRC K5/387	Research on the development and production of membrane systems	1991-1993	EP Jacobs (Institute for Polymer Science, University of Stellenbosch)	<ul style="list-style-type: none"> - Fabric supported membranes: design productive hydrophilic PES and PS membranes in the 100 000 dalton-size exclusion range - Fabric supported membranes: generate unskinned membranes with pore sizes in the typical 0.5 to 1 micrometer size-range - Unsupported membranes: set up medium-scale production equipment and protocols to produce membranes which are consistent in performance and integrity - Develop a standardised membrane device for field evaluation studies
WRC K5/553	Application of capillary membranes in the biotechnological treatment of industrial effluents	1993-1994	EP Jacobs (IPS, US) P Rose (Department of Biochemistry & Microbiology, Rhodes University)	<ul style="list-style-type: none"> - Separation and recovery of algae produced during the treatment of effluents with a biological algae production system. - Use of immobilised enzymes to remove phenol from effluents.
WRC K5/548	Investigation to upgrade secondary treated sewage effluent by means of ultrafiltration and nanofiltration for municipal and industrial use	1993-1994	EP Jacobs (IPS, US) in collaboration with the Uitenhage Municipality	<ul style="list-style-type: none"> - Long-term reliability and performance of different membrane types - Relationship between recovery, pressure and linear velocity on the one hand, and productivity and quality on the other hand - Maximum recovery achievable - Membrane fouling tendencies and cleaning techniques
WRC K5/618	Development of specialised cross- and transverse-flow capillary-membrane modules	1994-1996	EP Jacobs (IPS, US)	<ul style="list-style-type: none"> - Conduct extensive literature survey covering all aspects of capillary membrane module fabrication - Develop techniques to pack and wrap 1 to 1.3m-long membranes in bundles of minimally 10m² surface area for lumen-feed membrane cartridges - Design module(s) with membrane filtration areas of up to 100m² to accommodate individual module-cartridge units

WRC project	Report title	Project timeframe	Project leaders & collaborators	Project objectives
WRC K5/632	Capillary membrane production development	1994-1996	EP Jacobs (IPS, US)	<ul style="list-style-type: none"> - Develop a single feed, concentrate manifolding system to accommodate: a permeate delivery pump to obtain control over volumetric flow rate of permeate, reversal of feed flow-direction, radial pulsed permeate-flow - Test the module and module-cartridge devices on real waters and/or effluent streams with high fouling potentials to determine their efficacy
				<ul style="list-style-type: none"> - Develop, establish and install the necessary techniques, production and ancillary equipment at IPS to support volume-production, treatment and handling of different capillary membrane systems at low cost - Generate necessary know-how to produce microfiltration membranes from poly(ether imide) and poly(vinylidene fluoride), which are engineering materials know for their chemical, hydrolytic and mechanical stabilities - Generate the necessary know-how for the production of hydrophilic capillary ultrafiltration and microfiltration membranes from CA for large-scale sterile filtration of river-water for domestic and industrial use - Provide test specimens of membranes and modules to interested parties for bench and applied studies - Supervise, teach and support post-graduate students from the tolerant membrane development and membrane application groups in producing membranes from newer materials, in capillary and/or tubular form for membrane development and application studies - Improve the know-how on the formation of thermally precipitated polypropylene MF membranes and ceramic membranes prepared on ultra- and microporous carbon support membrane filters

WRC project	Report title	Project timeframe	Project leaders & collaborators	Project objectives
WRC K5/687	Membrane-based biotechnological systems for treatment of organic pollutants in water (in connection to water supply in rural and peri-urban areas)	1995-1997	SG Burton (Department of Biochemistry & Microbiology, Rhodes University) EP Jacobs (IPS, US)	<ul style="list-style-type: none"> - Identification of suitable organisms and enzymes, including exploration of novel systems via a screening programme involving indigenous and local sources - Characterization of these biocatalytic systems and conditions for their culture/isolation - Optimisation of the efficiency and capacity of such systems for degradation of aromatic pollutants in continuous processes - Establishment of the range of organic pollutants which can be degraded and removed from water by biocatalytic systems - Extension of the systems to the treatment of real effluents - Further investigation, and hence definition, of the enzymic mechanisms involved in the functioning of the biocatalytic systems
WRC K5/764	In connection with research into water supply to rural and peri-urban communities using membrane technologies	1996-1998	EP Jacobs (IPS, US) VL Pillay (Water Technology Group, Durban Institute of Technology)	<ul style="list-style-type: none"> - Determine the usefulness of ultrafiltration as a single-step clarification operation to provide good quality potable water from water which is unfit for direct human consumption, via field trials in various sites in the country. - Devise and demonstrate mechanical/physical/chemical techniques to improve the productivity, performance and energy-efficiency of the ultrafiltration membrane system. - Design a package demonstration filtration unit in collaboration with the Department of Chemical Engineering at the ML Sultan Technikon, based on the technology that was developed at Mon Villa. A modular demonstration plant to be erected at a suitable site in collaboration with Umgeni Water. - Study and model the ultrafiltration process (operation and cleaning protocol) to ensure optimal performance of the membranes and ancillary equipment for a selection of feed waters. - Provide a final operating protocol and a design manual for a package capillary membrane treatment facility to provide potable water to communities between 50 and 1000, or more people, in the rural or peri-urban areas of South Africa.

WRC project	Report title	Project timeframe	Project leaders & collaborators	Project objectives
WRC K5/769	Development of the fabrication protocol for the production of capillary membranes and special modules for the low-cost treatment of contaminated water	1997-1999	EP Jacobs (IPS, US) P Swart (Dept of Biochemistry, US) MW Bredenkamp (Dept of Organic Chemistry, US)	<ul style="list-style-type: none"> - Institute a series of lectures, in collaboration with ML Sultan Technikon, to introduce Chemical Engineering students to pressure-driven membrane technology. This will include the design and construction of small-scale membrane test loops to allow the study of basic transport phenomena. - Devise fabrication protocol to produce capillary membranes with enhanced properties for use in water filtration and extractive adsorption of contaminants in aqueous streams - Develop fabrication protocol to produce capillary membranes with special functionality to allow enzymes to be immobilised in a membrane bioreactor for the treatment of aqueous effluent or other product/process streams - Expand the range of neutral surface adsorptive coating materials to include materials with cationic and anionic moieties - Devise simple protocol to modify the surface chemistry of operational membranes by adsorptive techniques to improve their anti-fouling characteristics and operating flux - Integrate membrane surface modification with cleaning protocol and determine the efficacy of such a combined approach in problematic applications such as the treatment of paper and pulp wastewater - Improve and upscale the design of prototype and semi-production 50m² axial flow capillary membrane modules for use in low-cost treatment operations - Improve and upscale the design of prototype and semi-production transverse flow modules by capitalizing on the greater back-mixing properties of this type of membrane device

WRC project	Report title	Project timeframe	Project leaders & collaborators	Project objectives
WRC K5/965	Research on capillary ultrafiltration membrane process and systems R&D	1998-2000	EP Jacobs & D Koen (IPS, US) VL Pillay (Water Technology Group, Durban Institute of Technology)	<ul style="list-style-type: none"> - Develop and evaluate capillary ultrafiltration membrane processes to produce a high-quality filtered product from (i) coloured surface water, (ii) high-turbidity waters (iii) eutrophic water and (iv) sea water before desalination by reverse osmosis, without the addition of chemicals. - Establish an operating and cleaning protocol for the cost-effective operation of capillary ultrafiltration processes in the above applications. - Develop simple flow destabilization strategies to improve mass transfer at low energy inputs. - Develop a protocol by which absorptive foulants can be identified, and evaluate environmentally friendly and biodegradable agents (detergents, enzymes and sequestrants) with which to clean membranes to maintain high product output. - Evaluate the performance and integrity of large-sized membrane filters. - Produce a set of conceptual designs for a reliable, robust, marketable cost-effective product. - Broaden the engineering manpower base in ultrafiltration process operation and process development.
WRC K5/1070	The development of small-scale ultrafiltration systems for the provision of potable water at point source treatment	1999-2000	EP Jacobs (IPS, US) VL Pillay (DIT)	<ul style="list-style-type: none"> - To engineer a reliable, robust, simple to operate and cost effective ultrafiltration process for the provision of potable water to small communities, from eutrophic, brown-coloured and turbid surface water - To develop and evaluate appropriate flux enhancement and cleaning strategies - To evaluate the economics and operating requirements of the process - To expand the countries skills base in terms of membrane technology and potable water provision - To demonstrate the process to potential user

WRC project	Report title	Project timeframe	Project leaders & collaborators	Project objectives
WRC K8/558	The evaluation of capillary ultrafiltration (CUF) for the production of potable water at Amatola Water	April 2003 – October 2004	EP Jacobs (IPS, US) VL Pillay (DIT)	<ul style="list-style-type: none"> - Evaluate the effectiveness and sustainability of the coupled FMS/CUF system in terms of sustained product quality, operation and maintenance - Determine whether FMS/CUF system meets local industry needs in terms of potable water provision to rural and peri-urban areas - Identify and improve any operational aspects of the FMS/CUF system that does not perform optimally during the field trials - Identify the most suitable system design/layout for possible commercialisation, and - Demonstrate the system to the Amatola Water Board and other users and role players in the field.

Appendix 2: Drinking water-related patents

- ◀ *Reverse pressure pulse generator II.* EP Jacobs, JP Botes, VL Pillay & SM Bradshaw. South African Patent application 2002/4394, March 2003. Patentee: Water Research Commission
 - ◀ *Reverse pressure pulse generator.* EP Jacobs, JP Botes, DJ Koen & VL Pillay. South African Patent application 99/4620, 29 March 2000. Patentee: Water Research Commission. (The above superseded this one)
 - ◀ *Method of making hollow fibre membrane.* EP Jacobs & RD Sanderson. Patentee: Water Research Commission. South African Patent 96/7520, 5 September 1996; United States Patent 5 833 896, November 1998. (Patent is active; licensed to Filter SA)
 - ◀ *Capillary membrane module potting and encapsulation method.* SE Domröse, EP Jacobs & RD Sanderson. Patentee: Water Research Commission. South African Patent 96/1580, 26 November 1997. (Technique used to fabricate modules. (Patent is active; licensed to Filter SA)
 - ◀ *Membrane module connectors.* EP Jacobs, SE Domröse & RD Sanderson. Patentee: Water Research Commission. South African Patent 94/0834, 8 November 1995. (Patent is active; licensed to Filter SA)
 - ◀ *Membrane arrangements.* EP Jacobs, SE Domröse & RD Sanderson. Patentee: Water Research Commission. South African Patent 92/8673, filed 11 November 1992. (Patent was superseded by 8)
-

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- ◁ Edward VA, Pillay VL, Swart P, Jacobs EP & Singh S (2003) 'Degradation of synthetic xylan effluent using a membrane bioreactor.' *SA Journal of Science*, 99:315-317
- ◁ Govender S, Jacobs EP, Leukes WD & Pillay VL (2003) 'A scalable membrane gradostat reactor for enzyme production using *Phanerochaete chrysosporium*.' *Biotechnology Letters*, 25:127-131
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- ◁ Pryor M, Jacobs EP, Pillay VL & Botes JP (1998) 'A low pressure ultrafiltration membrane system for potable water supply to developing communities in South Africa.' *Desalination*, 119(2):103-111

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- ◁ Anselme C & Jacobs EP (1996) 'Ultrafiltration.' In: *Water Treatment Membrane Processes*, edited by J Mallevalle, PE Odendaal and MR Wiesner, McGraw Hill
- ◁ Taylor JS & Jacobs EP (1996) 'Reverse osmosis and nanofiltration.' In: *Water Treatment Membrane Processes*, edited by J Mallevalle, PE Odendaal and MR Wiesner, McGraw Hill

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- ◁ Allie A, Swart P, Maartens A & Jacobs EP (1999) *Pre-treatment of UF membranes with non-ionic surfactants: An abattoir case study*. 3rd WISA-MTD Workshop, Drakensville Resort, KZN, 26 – 29 September 1999
- ◁ Botes JP, Jacobs EP, Bradshaw SM & Pillay VL (1999) *4 1/2 Years experience of capillary membrane operation: The Mon Villa case study*. 3rd WISA-MTD Workshop, Drakensville Resort, KZN, 26 – 29 September 1999
- ◁ Botes JP, Jacobs EP, Bradshaw SM & Saayman HM (1997) *Long term evaluation of a UF pilot plant for potable water production*. 2nd WISA MTD Workshop, Aventura Spa Badplaas, 20 24 October 1997

- ⤷ Bradshaw SM, Jacobs EP & Marais PC (1999) *The hydrodynamic characterisation of an axial-flow membrane module*. 3rd WISA-MTD Workshop, Drakensville Resort, KZN, 26 – 29 September 1999
- ⤷ Jacobs EP & Bessarabov D (1996) *Membrane morphology*. Envig one day seminar on Membranes in industrial applications, 30 August 1996, Debex, Johannesburg
- ⤷ Jacobs EP, Botes JP, Burton SG, Leukes WD, Edwards W & Saayman HM (1996) *Novel capillary membranes for wastewater bioremediation or potable water production*. XIV National Symposium, Membranes in Chemical and Biochemical Industries, 16 17 February 1996, Indian Institute of Technology, Delhi, India
- ⤷ Jacobs EP, Botes JP, Pillay VL & Bradshaw SM (2001) *Reverse-pulse ultrafiltration in potable water production*. Engineering with Membranes, 3-6 June 2001, Granada, Spain
- ⤷ Jacobs EP, Botes JP, S Bradshaw & Saayman HM (1996) *Membrane filtration in potable water production*. ICOM96, 18 23 August 1996, Yokohama, Japan
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- ⤷ Jacobs EP, Pillay VL, Swart P, Bradshaw SM, Maartens A, Botes JP & Pryor M (1999) *Ultrafiltration: A new but acceptable technology for potable water production*. International Congress on Membranes and Membrane Processes, Toronto, Canada, 12 - 18 June 1999
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 - ◀ Maartens A, Swart P & Jacobs EP (1997) *Humic membrane foulants in natural brown water: Characterization and removal*. 2nd WISA MTD Workshop, Aventura Spa Badplaas, 20 - 24 October 1997
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 - ◀ Offringa G, Jacobs EP & Burton SG (1996) *New ultrafiltration capillary membranes for use in potable water production and wastewater bioremediation*. Proceedings of Emerging Technologies, VII, Antwerp, Belgium, 1996 (SA I SA2)
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CASE STUDY 7 TOWARDS THE DEVELOPMENT OF AN APPROPRIATE EXTENSION MODEL APPROACH FOR SOUTH AFRICA

Agricultural (over) extension

A participatory action research project, led by Prof Gustav Düvel of the South African Institute for Agricultural Extension, University of Pretoria

by Gerrit Loots



Small-scale farmers near Alice in the Transkei. Photograph courtesy of: **ARDRINEWS**, July and December 1999.

CONTENTS

Abbreviations	313
1 Introduction	314
2 Context	315
2.1 A short history of agricultural extension in South Africa	315
2.2 Organisational context: The South African Institute for Agricultural Extension	320
3 Key descriptors of the agricultural extension project	325
3.1 Project context	325
3.2 Project dynamics	327
3.3 Project objectives	328
3.4 Size and composition of the project team	329
3.5 Project funding	330
3.6 Project outputs and deliverables	330
3.7 Intellectual property	330
4 Mode of knowledge production	330
4.1 The participatory action research methodology	330
4.2 Phases in the development of the project	333
5 Mode of knowledge utilisation	341
5.1 The utilisation context	341
5.2 The participatory process: A client (utilisation) perspective	345
5.3 Indicators of project success	351
6 Concluding observations and lessons learnt from this case	356
6.1 Research methodology	356
6.2 Utilisation progress	356
6.3 Future utilisation success?	357
Data sources	359
Face-to-face interviews	359
Telephonic interview	359
E-mail response to additional questions	359
Questionnaire	359
Publications and documents	359
Appendix 1: Summary of findings and recommendations	360
Appendix 2: Western Cape utilisation/implementation timeline	362

Abbreviations

AIAEE	Association for International Agricultural and Extension Education
ARC	Agricultural Research Council
CLIARD	Centre for Low Input Agricultural Research and Development
HEI	Higher education institution
HSRC	Human Sciences Research Council
NDA	National Department of Agriculture
NGO	Non-governmental organisation
PPEA	Participatory Programmed Extension Approach
SASAE	South African Society for Agricultural Extension
SAIAE	South African Institute for Agricultural Extension
WCDA	Western Cape Department of Agriculture

1 Introduction

Agricultural extension in South Africa has gone through various methodological cycles over the past century since its small beginnings in the early 1920s. Seen from the perspective of functioning as a vital knowledge partner to farmers, with the broad goal of improving the sustainability and profit of agriculture businesses, the relationship between extension theory and service is mirrored in the politics and farming praxis of the day. During the first half of the twentieth century, farming evolved from an extensive and mainly self-sufficient focus towards more intensive and commercial farming practices. Agricultural extension endeavoured to keep pace with these developments through various methods of addressing the knowledge needs of farming communities at specific times, be it through publications, farmer days, research institutes, travelling exhibitions, extension schools or itinerant teachers. The applicability and transferability of knowledge through extension was often reflected by attitudes towards extension and the measure of uptake of the new knowledge in farming praxis:

[] agricultural educational opportunities were often mistrusted or dismissed by farmers as only “book farming”, and was not readily accepted as valid by the farmers themselves for their own situations. (Richardson, 2003)

Agricultural extension was also influenced by apartheid ideology. Although many small-scale farmers were involved in farming, particularly in the so-called “homelands”, they were not recognised as being part of “serious” agriculture, which was increasingly dominated by white commercial farmers. Extension services funded and managed by the national Department of Agriculture (NDA) therefore focused on the needs and challenges as presented by commercial agriculture. Reflecting the political realities up to 1993, the agricultural ministry at national level was divided between three agricultural departments, namely the Department of Agriculture, the Department of Agricultural Development, and the Department of Local Government, Housing and Agriculture. These independent functions were grouped together in a new single national department on the 1st of April 1993 (Saaiman 1998:55).

Political changes introduced radical re-alignment in the focus of agricultural extension in South Africa. Small-scale farming as an important factor in the improvement of the living conditions of many previously disadvantaged South Africans, particularly in rural areas, was brought onto the political agenda and, in 1993, a division for small farmer development was established in the Department. The focus of extension work shifted again to small-scale farming as well as assistance through the Land Reform programme (Saaiman 1998:55).

The shift in focus from commercial to small-scale farming, as well as the loss in extension capacity in provincial departments during the last decade, caused the relevance and effectiveness of extension services in South Africa to be questioned by some:

Extension in South Africa finds itself at a crossroads situation, which has been brought about by a multitude of factors. The extension services have been blamed for failing to deliver effectively. Their credibility has been questioned and lacking competence has led to a waning confidence and commitment on the part of the extension workers. Where successes have been achieved, there has usually been an absence of tangible evidence due

to a lack of accountability and systematic and regular evaluation. This has been exacerbated by changes within the country as well as changes in the international extension environment, which have led to additional constraints demanding a reconsideration and adaptation of extension approach. The political transformation in 1994 led to a democratisation and restructuring of the extension service and a large-scale shift in focus away from the commercial sector towards the small-scale and subsistence farmer. Noteworthy are also the macro-economic changes in line with international reforms, which included the removal of subsidies, decentralisation, down sizing of extension services and increased pressure towards privatisation and pluralistic extension. The Department of Agriculture is under pressure to come up with innovative ways of responding to the numerous challenges. (Gustav Düvel, interview, 10 November 2003)

The particular extension needs of small-scale farmers provided the rationale for revisiting the extension approach in South Africa and led to the tender process by the NDA and the request to the South African Institute for Agricultural Extension to take on the research project on developing a more appropriate extension approach for South Africa.

2 Context

2.1 A short history of agricultural extension in South Africa¹

The emergence of modern agricultural extension

According to Jones & Garforth (1997:5), the first modern form of agricultural extension emerged during the potato famine in Europe in 1845. The Earl of Clarendon sent a directive to the Royal Agricultural Improvement Society of Ireland “to appoint itinerant lecturers to travel around the most distressed districts to inform and show small farmers, in simple terms, how to improve their cultivation and how to grow nutritious root crops other than potatoes” (Jones & Garforth 1997:5). This more institutionalised form of agricultural extension – largely publicly but also privately funded – spread to other regions in Europe, and particularly Germany, which later became the model for other countries (Jones & Garforth 1997:6).

In the United States, two developments after 1850 gave substantial form and shape to agricultural extension in that country (Jones & Garforth 1997:7). The first was the emergence of the farmers’ institute movement that was later to “become a national institution with federal support and supervision” (ibid). The second was the Morrill Act of 1862. Through the Act, the northern states were allocated pieces of land that they were to sell or use “for profit and the proceeds used to establish at least one college – hence, land grant colleges – that would teach agriculture and the mechanical arts” (National Research Center 1995:1). The land grant colleges were intended to bring a liberal, practical education to the working classes that would have “direct relevance to their daily lives” (NASULGC 1999).

¹ The discussion on agricultural extension is drawn from the literature review on research utilisation: Bailey, TG & Mouton, J (2005) *A review of models of research utilisation*. Centre for Research on Science & Technology, University of Stellenbosch.

Teaching was the first function assigned to the land grant colleges. Two other core functions developed over time. In the late 1880s, a research function was introduced “which recognized the need for original research to underpin the teaching of agriculture and help develop agricultural innovations” (National Research Center 1995:8). The dissemination of research findings to farmers was organised through the establishment of agricultural experiment stations at each of the land grant universities on the basis of the Hatch Act in 1887 (Jones & Garforth 1997:7; NASULGC 1999).

This system of dissemination was later enhanced with the introduction of ‘extension’ as the third function of the colleges (National Research Center 1995:8). This was brought about via the 1914 Smith-Lever Act that provided for the creation of Cooperative Extension Services associated with each land grant institution (NASULGC 1999). These Services were coordinated by the federal, state and local county governments (Jones & Garforth 1997:8; National Research Center 1995:8).

Agricultural extension in South Africa

At the time of the Smith-Lever Act in the United States, state agricultural extension in South Africa was still in its nascent state. The first official agricultural extension service was established in 1925 in the newly formed Division for Agricultural Education and Extension in the Department of Agriculture (Penzhorn 1987:12).

In the fifteen years prior to this (after the formation of the Union in 1910), the predominant form of extension work was the provision of advice to farmers based on research conducted at institutions such as Onderstepoort and the agricultural colleges such as Elsenburg, Cedara and Potchefstroom (Saaiman 1998:52). It was up to the farmers themselves to interpret and apply the information that was brought to their attention.

Three factors led to the establishment of agricultural extension services in South Africa according to Saaiman (1998:52). The first was the appearance of a report in the early 1920s by Colonel Heindrich du Toit that drew attention to the dangers of water and wind erosion. Secondly, Colonel du Toit, who had heard about the land grant colleges and extension services in the United States, advocated the establishment of a separate extension service in this country. Thirdly, the introduction of the Department of Agriculture’s ‘demonstration train’ served as an important form of publicity to the farmers of the newly established extension services.

In the 1930s, ‘co-operative demonstrations’ were introduced as a method of extension work, based on the idea that “seeing is believing” (Penzhorn 1987:12; Saaiman 1998:53). Amongst others, extensionists demonstrated improved fertiliser practices, and the benefits of a new imported grass which was aimed at helping farmers to overcome their grazing problems and to prevent water and wind erosion (Penzhorn 1987:12). While these co-operative demonstrations were very popular and successful in the 1930s (Penzhorn 1987:13), it was soon realised that they were inadequate insofar as they focused on single farm activities rather than on the farm as a whole system (Saaiman 1998:54).

This gave rise to a new phase in agricultural extension in the 1940s known as ‘whole farm planning’ after the promulgation of the Land Conservation Act in 1946 (Penzhorn 1987:13;

Saaiman 1998:54). One of the primary motivations for this approach was based on the finding in agricultural science that erosion could best be dealt with by covering land that was vulnerable to erosion with natural veld, and by implementing a crop rotation system (Penzhorn 1987:14). The extensionists needed to demonstrate these strategies over time in order to convince the farmers that they worked.

During the 1940s, a number of other problems led to further changes in agricultural extension. For instance, it had become apparent that the scientific assistance and advice available to extension officers from the Pretoria Head Office was inadequate. This ushered in the phase of decentralisation in agricultural extension services (Penzhorn 1987:14). This started in 1945 with the establishment of a Division for Land Conservation and Extension which effectively brought the extension workers into closer contact with researchers and agricultural engineers, reducing their sense of isolation (Penzhorn 1987:15).

But, the lack of promotion opportunities still plagued the extension officers. As part of the decentralisation process, in 1946 the Department divided the country into five districts with headquarters in Pretoria, Bloemfontein, Pietermaritzburg, Queenstown and Stellenbosch (Saaiman 1998:54). This was later extended to seven districts and, by 1957; there were 206 extension posts (ibid) to which extensionists could aspire to for promotion (Penzhorn 1987:15). The general work performance of the extension officers also improved since they could now work as a team (instead of as individuals) addressing problems and needs within their districts.

Another issue had to do with the lack of formal, specialised education and training in extension. Up until the late 1940s, extension officers gathered once a year for courses in their area of speciality, offered by lecturers and researchers at the agricultural colleges (Penzhorn 1987:14), but there were no specialised courses for extension work itself. Extensionists began to demand education and training in agricultural science, as well as in methods of teaching and working with adults. The struggle for the introduction of university-level education began during these years but it was only in 1958 that a Department of Agricultural Extension was established at the University of Pretoria, which offered postgraduate degrees in agricultural extension (Penzhorn 1987:16; Saaiman 1998:54).

Some years after the decentralisation of the extension services, the Department underwent another major reorganisation, with the result that the districts were jointly responsible for extension, teaching, research and conservation (Penzhorn 1987:16). At the same time, a number of specialised research institutes were established and, where available, extension services were coupled with faculties of agriculture in the district. This led to closer co-operation between research and extension in the districts, which, it was hoped, would make it easier for research results and technologies to find their way to the farmers, and for new ideas and discoveries to reach the researchers. However, this interaction between research and extension still depended largely on the efforts and interest of individual extension workers and researchers.

In 1968 a report of the Interdepartmental Study Committee for the Use of Agricultural Land gave rise to a whole new approach to extension work (Saaiman 1998:54-55). The

report emphasised the importance of 'optimal resource utilisation' that shifted the mandate of the extension services from land conservation to the introduction of farming systems that would bring about a more balanced and integrated approach to the utilisation of resources.

As time passed, farming became more specialised and there were calls for greater specialisation among the extension workers, a closer working relationship between them and the researchers, and decentralisation of extension services. This led to the establishment of the first agricultural development centre on the Outeniqua experimental farm in 1989 where a team of specialists from across the disciplines focused their attentions on the specific problems of the region (Saaiman 1998:55). Ongoing research, extension work and short courses were now located under one roof, working together to bring about sustainable and integrated farming systems.

Recent South African agricultural extension history

Extension methodology in South Africa influenced and followed the cycles of agricultural praxis. At the time of the establishment of extension services in the country (1925), agriculture consisted to a large extent of extensive and subsistence farming. As farming practice and focus gradually became more specialised and intensive, extension services had to follow suit. Calls for greater specialisation among extension workers, a closer working relationship between them and researchers, and the decentralisation of extension services were coming from the well-established commercial farming sector.

Due to political reasons, national management and intervention approaches to agriculture were based on a definition of race up to 1993. As a result separate ministries/departments managed separate agricultural communities. South African agriculture was divided between three departments, namely the (white) Department of Agriculture, the (black) Department of Agricultural Development, and the (Indian and Coloured) Department of Local Government, Housing and Agriculture. On the 1st of April 1993, the functions of these departments were grouped together in a new national Department of Agriculture (Saaiman 1998:55).

The plight of the rural, often very poor communities now became central in the focus of the NDA. Agriculture was deemed the key to unlock a better future for many households in rural areas across the country. Therefore, in the context of the new South Africa, the issue of small-scale farming was brought onto the political agenda and, in 1993; a division for small farmer development was introduced in the Department. The focus of extension work shifted again, this time to small-scale farming as well as assistance in the Land Reform programme (Saaiman 1998:55). Strangely enough, it resembles the kind of service that was needed at the beginning of the previous century at the time of the 1933 depression, the so called "arm blanke" (poor white) problem, and after the first and second world wars, when agriculture was viewed by the government of the day as the saviour for many socially marginalised whites. This was the time when thousands of war veterans were relocated/resettled in irrigation schemes (such as Vaalharts and Riversdale) to make a new life. It was the era of development through agriculture and small-scale farming.

At the time, actions taken to improve the plight of poor whites were similar to the land reform projects of today. Mr Ben Saaiman explained this as follows:

Land reform projects had different targets, but the principle remains the same. You are making land available, resettling new entrants into agriculture. Very similar to fifty, sixty years ago. And the focus of extension is very much what then these new entrants need to get them into your system, very much the same as land reform. Many of them are farm labourers getting into agriculture as an owner or entrepreneur now. Not a labourer just taking orders pruning the trees etc. but now have to run the farming business. And our extension focus is upon these new entrants. The question of focus was one of the aspects of the study. We should get some indications of where our focus should be. The focus of our extension service has definitely shifted towards small-scale farmers. (Ben Saaiman, interview, 13 November 2003)

The last decade of the twentieth century brought fundamental change to South Africa, in the political arena but also to other spheres of life, including agriculture. Extension services would also be changed drastically by these events:

I was to head a task team that did a study on small-scale agriculture. We had three departments of agriculture namely the Indian department, the Coloured department and the White department. And I worked for the white department which did not service small-scale farmers at all. It was commercial, white agriculture. But in '94, realising what was happening in the country, management said we should start looking at the other sector of agriculture, so I led a task team in that respect. It was a different ball game to white commercial farming. Subsistent, poor people, from an extension perspective, was something totally different. Even the best advice, if a person cannot afford the advice, then it is worth nothing. To reflect on how the Department should adapt and change its programmes to assist small-scale farmers, the Department decided to form a new division to provide services to small-scale farmers. At that stage, we had a Training College at Kromme Rhee, which was for coloured farm labourers basically and small-scale farmers, we followed the same route. We had Elsenburg College for white students, Kromme Rhee for coloured students, so within the department they decided they have an extension service for white farmers, so let's form a new one for coloured farmers, coloured, small-scale farmers, and I was appointed head of that division from basically 1994 []. So, the Department responded about four days after the elections saying, yes we have a new extension service specifically for small-scale farmers. Terrific! Politicians like these things. I had a small team, about twelve extension officers, and we focussed on small-scale farmers only. I had nothing to do with commercial farmers. In 1997 they closed down Kromme Rhee College and said we cannot afford two agricultural colleges within two kilometres of each other. They also said, let's rather form one strong extension service. And I actually got the job of that as head of extension for the entire spectrum of agriculturalist from food security back yard to small-scale to commercial to highly intensive export farms. (Ben Saaiman, interview, 13 November 2003)

Similar to the situation at the start of the previous century, now again at the end of the twentieth century, agriculture is perceived to have the capacity to bring better living conditions to the marginalised and rural poor. It is in this context that agricultural extension today is challenged to shoulder the responsibility by being a cost-effective knowledge partner.

As elsewhere in the world today, not only the government employ agricultural extension officers in South Africa. Increasingly, other sectors – such as the agricultural, chemical and fertiliser industries, agricultural co-operatives, and non-governmental organisations involved in rural development, draw on the expertise of extensionists (WCDA 2002). They also act as private consultants.

A range of non-governmental organisations and research institutes across the country also provides support for agricultural extension. An example is the Centre for Low Input Agricultural Research and Development (CLIARD) based in KwaZulu-Natal. The aim of the organisation is “to develop the organisational and individual capacity of rural people around sustainable farming methods, research on specific crops and problem solving with farmers” (Sangonet 2002). The organisation also provides training for agricultural extension officers, agricultural assistants and farmers.

The field of agricultural extension as an area of specialisation has continued to grow in South Africa and around the world. Many universities offer postgraduate qualifications in the field and various journals dealing with agricultural extension have been introduced². The government however, mainly funds extension services in South Africa.

2.2 Organisational context: The South African Institute for Agricultural Extension

The South African Institute for Agricultural Extension (SAIAE) was established in 1980 through the initiative of the South African Society for Agricultural Extension. At the time, there was a significant need on the part of the extension departments for in-depth research into agricultural extension and related developmental needs. It was envisaged that the Human Sciences Research Council (HSRC) could do this focused research. This did not materialise. The result was the establishment of the Institute at the University of Pretoria:

It started very small, and still it is not a big institute. It was originally funded by the Department of Agriculture in the form of a seconded researcher. But since then, well, we are trying basically to co-ordinate extension research in the country. We are trying of course to do a lot of research ourselves, and the main functions of the institute would be research; secondly, we do outreach actions in terms of in-service training, and, of course, to some degree also, consultancy work. (Gustav Düvel, Interview, 17 August 2000)

The Institute is part of the Faculty of Natural & Agricultural Sciences. The Department for Agricultural Extension & Rural Development is involved in various kinds of extension, such as primary health care, while the Institute focuses mainly on agricultural extension.

² An example of this is the establishment of the *South African Journal of Agricultural Extension* in 1971.

Staff complement

Four full-time researchers (including the Director) and one part-time technical assistant are presently working in the Institute. Salaries are paid by the Faculty and therefore are not reflected in the Institute's budget. Postgraduate students form an important part of the research activities of the Institute. Twenty students (7 PhD and 13 Masters) were involved during 2002/3 on a part-time basis in research projects.

Difficulties with regard to human resource capacity are regularly expressed in annual reports reflecting on the Institute's business during the last years. This is also stated in the annual report for the period 1 January 2002 to 31 December 2002:

The unsatisfactory staff situation has continued for most of the report period. Only towards the end of the year has it been possible to fill the vacancy left by the resignation of Prof. C A J Botha. (Düvel 2002b)

A main reason for the human resource capacity problem of the Institute is perceived to be the fact that some of the experienced researchers are due for pension, while experienced researchers to replace these are hard to find:

One is basically on pension already and kept on because we couldn't find somebody else. Another one is busy with his PhD. so, he has limited capacity to help with research. (Gustav Düvel, interview, 10 November 2003)

Furthermore, when large projects come along, such as the one that is the focus of this case study (*Towards an appropriate extension model for South Africa*), this impacts negatively on the already scarce research resources of the Institute.

Funding

The Institute is very dependent on contract income. Changes in the way departments or institutes are allowed to tender for contracts, has made it more difficult to compete for work:

For example, all research that is done on contract or tender basis, now has to go through a certain company of the University, which makes it very difficult in terms of negotiations, in terms of the image that you have developed. [] Officially there exists now a front-organisation. It also makes it much more difficult in terms of our flexibility. It is limited through that. (Gustav Düvel, interview, 10 November 2003)

The principal reason for the change in tender policy was the University of Pretoria's intensified management of its intellectual property and research outputs in order to ensure that recognition and royalties would go the way of the university.

Internationally, many funding links exist that are not topic- or project-specific. The biggest funder by far is the Department of Agriculture. Ninety five percent of extension in South Africa has been state funded up to now. Close collaboration exists between the Institute and the national Department of Agriculture (NDA). Funding from external donors such as the Dutch Government is, in most cases, also channelled through the NDA.

Relationships and agreements with the funders also drive, on national and provincial levels, the focus of consultancy and training. The Dutch and the Danish governments allocated funding earmarked for particular projects. The donor, in these cases, determined the focus of the research.

Funding from the University of Pretoria is at a low level, in the region of 5% of the annual budget. The major contribution, in the order of 70%, comes from the Departments of Agriculture in the different provinces, while the remainder would be from funders. The Institute experiences the fact that such a low level of financial support is received from its own institution, as an inhibiting factor. As Prof Düvel commented: "The fact that we are not funded by the University makes it very difficult; you have to give quite a portion to the University of any earning" (Gustav Düvel, interview, 17 August 2000).

Research portfolio

The main activities of the Institute include research, consultancy work and training. An advisory board that consists of one of the vice-principals, the Dean of the Faculty of Natural & Agricultural Sciences and the Director of the Institute governs its research activities. Furthermore, representatives from the nine provincial Departments of Agriculture, as well as organised (commercial) agriculture and the Agricultural Research Council (ARC), are represented on the board. The main purpose of the board is advisory in terms of the research that is done.

Research shifts

Since the start of the Institute, fundamental research necessary for a solid theoretical base of extension had to be done. Continued dialogue and training of extension personnel countrywide, with the aim of improving the theoretical framework of extension, proved to be of great value. New extension models were taken up into extension praxis and contributed to bring the total service onto a better footing.

The first emphasis was on finding models for change (adoption models, behaviour change models). So that took a number of years. We have now quite sophisticated models in place, which are presently adapted very widely. (Gustav Düvel, interview, 17 August 2000)

International changes in extension paradigms also impacted on extension approaches in South Africa. The effect of post-modern perspectives on knowledge and, more particularly, indigenous knowledge and the role of communities in collaborative ventures with knowledge partners to improve their conditions has put more emphasis on participatory extension.

We have seen internationally the paradigm shift towards more participatory approaches, and this of course also affected extension and how it goes about doing its work, meaning that the research also of course has changed. We have, in recent times, done lots of work on, for example, the different participatory methods that are being used, compared them and tried to refine the approaches. But in many cases of course, we are very often, in terms of our programmes, a little bit more reactive than proactive, and this is simply because, again, of limited funding, and reliance on employers who have students. (Gustav Düvel, Interview, 17 August 2000)

The research focus is also informed by specific needs and the way different organisations require research to be done. In some cases, researchers or students are seconded to the Institute:

The other focus of our research is largely determined by need and come to us from different organisations and who second to us researchers or students. In other words, we don't always have, as it were, a research programme where we plug in different people that are available to some degree; we are very often forced to respond to needs of different organisations who will then also make available researchers. (Gustav Düvel, interview, 10 November 2003)

This is mostly the case with provincial Departments of Agriculture that second some of their personnel to the Institute with the aim of particular research to be done and capacity to be built.

The changes in both research and extension practice since 1994 described in Section 2.1 above are also reflected in the focus of the Institute's teaching and research activities.

In other words, where we previously were perhaps very strongly in the commercial field of development we have now left that completely. [] The political transformation in 1994 led to a democratisation and restructuring of the extension service and a large-scale shift in focus away from the commercial sector towards the small-scale and subsistence farmer (Düvel 2002b).

Research outputs

Five research projects were completed during 2002 while twenty-four other projects are continuing. Eight of these projects focus on research topics of value to other African countries such as Botswana, Ethiopia, Namibia and Uganda. In most cases students from these countries are involved in the research project (Düvel 2002b).

Five publications were published in accredited journals while one refereed conference proceeding was published. A paper was read at a conference of the Swaziland Society for Agricultural Extension.

The training and consultation brief of the Institute remains an important activity. Most of the previous programmes have been taken up in the Advanced Diploma in Extension and Rural Development, established in 2001 and now fully integrated as a formal programme (Düvel 2002b). The KwaZulu-Natal province is currently a major focus of the programme with planning to incorporate the Eastern Cape province.

Primary users of research

The most extensive users of research (about 80%) are all the provincial Departments of Agriculture around the country. The remaining 20% is made up of other government departments, such as Environmental Affairs, agricultural co-operatives and non-governmental organisations in the field of development (Gustav Düvel, Interview, 17 August 2000).

According to Prof Düvel, there are a number of examples where potential users took up the Institute's research results:

[] many of our models are now widely used. Many of the sort of structures that we have researched and recommended are widely being used. It is of course also facilitated by the fact that we now have become very much involved in training; the Institute did some in-service training for a number of years for departments, for organisations etc., very much tailored to their needs. This ultimately became so much that we couldn't handle it; and, at the same with the transition, the need for any training to be with a certificate or recognised diploma etc. We started last year with an Advanced University Diploma which has now been registered which is quite a big programme of training at different satellite campuses. (Gustav Düvel, interview, 17 August 2000)

Teaching and postgraduate research supervision

Postgraduate students have always been an important aspect of the Institute's focus. A big shift has taken place in the race composition of the student body from mainly white students to a majority of black students (90% of the postgraduate group in 2003) originating from all provinces and various countries in Africa. The gender profile of the student body has also changed from being predominantly male-dominated: 50% of postgraduate students are presently female. According to the 2002/2003 annual report, 15 PhD, 10-15 Masters and 16-20 Honours students are enrolled at the Institute.

A further specific need for the institute's know-how is capacity building amongst provincial extension personnel.

If we can get more funding, we can have more of an outreach function which we are basically prevented to do due to all personnel being fully, you know, lecturing personnel and not having the time. For example there are annual workshops which are to be arranged by and convened by the representatives of the different provinces, which we just can't hold because of the time. (Gustav Düvel, Interview, 17 August 2000)

During the report year some *ad hoc* training inputs in terms of curriculum development were made for Africare for the training of extension managers in parts of Limpopo province. Training was also provided in the Free State province. A significant outreach of an indirect educational nature has been achieved through the National Extension Project in workshops all over the country and involving about 1000 extensionists. According to Prof Düvel, the recommendations made regarding training could, if accepted, have far-reaching results (Düvel 2002b).

In general, there is a 50/50 ratio of research to teaching in the Institute (Düvel 2000). According to Prof Düvel, the ratio between research, training and outreach differs for different projects. For example, in one of the current contracts for the Department of Agriculture, the ration of research to teaching is more like 40/60, while within outreach activities, the ratio between research, training and consultancy is 50/40/10 (Gustav Düvel, interview, 10 November 2003).

International contacts and collaboration

Links and collaboration with African countries are mostly established through students from these countries studying at the SAIAE.

We have quite a few programs now with Ethiopia, with Uganda and so on. In the case of Ethiopia, for example, they sent a group of students, a number of PhDs; so there's a whole programme on that. This then leads to contact in the sense that in order to make their research appropriate and useful for them they want it to be done in their country. (Gustav Düvel, interview, 17 August 2000)

International links between the SAIAE and other bodies are mainly reflected in the organisation of an international conference jointly hosted by the international Association for International Agricultural and Extension Education (AIAEE) and the South African Society for Agricultural Extension (SASAE). This conference was primarily organised by the SAIAE Director, in his capacity as the then president-elect of the AIAEE. Since the international conference in May 2003, Prof Düvel has been the President of the AIAEE (Düvel 2002b), which has facilitated a whole new range of significant international linkages. Besides the Departments of Agriculture, it appears that there are far fewer local linkages:

I have got a lot of people with whom I am in close interaction. For example, I'm now in the International Leadership Committee of the International Association, and through that of course we have a lot of contact, which has really opened up possibilities which I never knew that existed, especially since isolation. And of course it costs something in terms of attending these conferences until one is also really recognised, but we are really fortunate as far as these linkages and networks are concerned. [] We have internationally a lot of links which are not topic-specific. Then, obviously, our biggest partner or funder, you could say, is the Department of Agriculture, because in this country, 95% of extension is state-funded. So, we have close collaborations with them and that also drives, not only nationally, but also with the different provinces where we are involved with consultancy, with training etc. [] As far as other organisations, local organisations, for example the ARC is concerned, there is much less linkages [] (Gustav Düvel, interview, 17 August 2000)

3 Key descriptors of the agricultural extension project

3.1 Project context

Agricultural extension during the late 1990s was perceived to be in a crisis nationally. As mentioned, a dramatic shift has taken place owing to transformation goals. This shift resulted in the restructuring the extension staff complement, particularly the front line extensionists, as well as the client base of extension. It became clear from research projects focussing on the status of extension services and outcomes, that a grave situation had developed. According to Prof Düvel in spite of significant amounts of the national budget spend on extension very few results are visible.

Prof Düvel emphasised the importance of the monitoring and evaluation of extension services, which is apparently sorely lacking:

You see, the big problem is, and I suppose it is in many fields, the primary objective is transformation. And anything else is of secondary importance. So there are millions, I think in the Limpopo province, about R600 million goes to extension. [] And when I tendered for the project, one of the things that was not part of the terms of reference and that I said I would do, would be to, in a way, evaluate the service. Because it is only once we really are disillusioned regarding what is happening, that people might sort of get a wake-up call and realise that really something has to be done. But I think to make an impact, one would have to go further and I don't know whether we can. One of the important things would be to really get transparency in the whole process. For example, if the whole service is based on cover-ups. It can't be different. Because people at the lowest level, they make inputs, they now write a report, obviously only the positive things, and this lofty report is presented to laymen, politicians, who don't know anything about the process and about what should happen, and what is happening, so there's no accountability, and we have often thought about it, in one way or other, could enforce accountability even if it is on the regional level. Let's say you would have an advisory board for that province to which that province is responsible and not only to the politician. It could really make a change. And then something could start happening, and this would also force the people to make sure they have the capacity and the personnel and the time and the people that can do the job. (Gustav Düvel, interview, 17 August 2003)

Extension services have almost reached a point of collapse as referred to by Eicher (2002) (quoted by Düvel in Final report 2002). He quotes South Africa's new agricultural strategy³, which reports that "support services to farmers in the former homeland areas have all but collapsed", and this in spite of the dramatic transformation from a dualistic service to one that is strongly focused on the previously disadvantaged small and subsistence farmers. With the shift towards the emerging or subsistence farmers, most provinces have scaled down or discontinued their service delivery to the white commercial farmers.

Funding from the Dutch Government in 1999, earmarked for research into new ways of doing agricultural extension, contributed towards new thinking on extension for a changed agriculture sector in South Africa. Funding in the region of R10 million was awarded to the NDA, which was subsequently divided amongst the provincial departments.

The Dutch government was looking at alternatives of doing extension or extension delivery. They have gone through a whole process of what was called privatisation in their own industry. (Gustav Düvel, interview, 10 November 2003)

Not all provinces were equally involved in this research with the result that not all the available funding was used. Some, however, such as the Western Cape Department of

³ Department of Agriculture (2001) *The Strategic Plan for South African Agriculture*. Pretoria: Department of Agriculture.

Agriculture, used the allocated R750 000 to investigate various ways of doing extension. The funding from the Dutch Government therefore stimulated new thinking on extension nationally, and was eventually introduced into the research process of drafting a new extension framework via the first national workshop in Midrand (see section 4.2).

These research activities in the provinces were underway during 1999 and 2000. It became clear to various role players in the extension community that a more focused effort and research drive should be embarked on in order to move towards clarity of thinking regarding agricultural extension in South Africa, focusing on developmental and small-scale farming. The NDA invited tenders for research to be done on the development of an appropriate extension model for South Africa within this context.

You hear about some research need and you put in an application or a tender for it. This was different in the sense that I was approached and requested to hand in a tender, which I was very hesitant or reluctant to do at that stage because I thought that we really were beyond capacity already. But, obviously realising the potential of such research, I gave in and put in my tender which I then won and that was the start of the project. (Gustav Düvel, interview, 10 November 2003)

3.2 Project dynamics

The National Extension Project conducted for the national Department of Agriculture was defined by the specific terms of reference of developing an appropriate extension model for South Africa.

The relationship between the national Department of Agriculture and the provincial departments had a big impact on the knowledge production side of the research process. The NDA, who was the initiator of the research, is linked to provinces in ways not always clearly defined owing to the fact that agriculture is, according to the Constitution, a provincial matter and to be managed through provincial structures.

The role of the NDA is defined as management towards a united and prosperous agriculture sector. In the new political dispensation after 1994 the country was divided into nine provinces, each with its own Department of Agriculture. The national Department of Agriculture is, however, still the central body overseeing national interest.

[The NDA] wants more say, and the provinces don't want that, and how to, I'm still looking for a model, I don't exactly know how [to bring] this together, because you can't prescribe, but you could demand accountability. And through that, comes the prescription or the national interest in the whole process. (Gustav Düvel, interview, 10 November 2003)

Prof Düvel remarked that this inherent tension impacted on the research dynamic. The development of a new approach to extension, which was a project conceptualised by the NDA, had to be managed in such a way that the full participation and buy-in from the provincial departments would be secured.

3.3 Project objectives

Guided by the Terms of Reference the following objectives were set for the project:

- ◀ To conduct a national workshop with representatives from all the nine provinces, with the following specific objectives:
 - ◆ To exploit the large reservoir of experience, knowledge and viewpoints found in the country.
 - ◆ To receive critical feedback regarding the different projects implemented in the various provinces designed to seek appropriate alternatives for Extension.
 - ◆ To discuss the lessons learnt or to be learnt from these projects as well as from any other successes recorded or experienced by the Provinces.
 - ◆ To become exposed to other alternatives reported to be successful abroad or in the country, with the purpose of widening the perspectives of delegates.
 - ◆ To gauge the perceptions of delegates regarding the acceptability of different systems and/or specific principles
- ◀ To develop in a participatory manner, i.e. with the involvement of a Programme Management Committee (with one representative from each Province) a discussion document identifying and introducing the variation and alternatives within the different extension principles. The purpose of the discussion document was
 - ◆ To be thought provoking and to stimulate debate and interaction about what has, in a participatory manner, been identified by representatives of all Provinces in a national Workshop as the most important principles of extension.
 - ◆ To identify and to create awareness and a wider perspective of the various dimensions and aspects within each of the principles.
 - ◆ To discuss and debate the acceptability of the various principles and the dimensions within each of them, in an attempt to obtain a reasonable degree of consensus.
 - ◆ To serve as a measure of how individuals from senior management level of Extension to frontline extension workers perceive the various issues related to extension approaches and their principles.
 - ◆ To form the basis for the development of a document on an appropriate extension approach for South Africa, which, on the basis of wide consultations and involvement of role players, will find acceptance and implementation in the quest for improving Extension in the country.
 - ◆ To achieve all the above, the discussion document had been designed as a form or questionnaire. However, the provision of personal viewpoints were to be preceded by intensive interactions and debate, in order to be as informed as possible. It is hoped that especially senior managers who normally have tight schedules, will take enough time to fully participate in the process and to help make the outcome worthwhile.

- ◀ To evaluate the effectiveness and efficiency of the current state extension service by means of interviews with frontline extension workers and, where possible, with farmers.
- ◀ To do an audit of the costs of public extension in South Africa.
- ◀ To table a report on the findings and a proposed extension approach and framework of principles that is, resources permitting, the outcome of a iterative process with the extension management of the different provinces to ensure acceptance, ownership and implementation. (Düvel 2002b)

3.4 Size and composition of the project team

Project leader and national programme manager: Prof GH Düvel

The support of the provincial Departments of Agriculture to the project was deemed by the national programme manager to be invaluable. An important aspect of the provincial managers' contribution was their participation in the workgroup of provincial programme managers. They took part in several workshops aimed at planning and guiding the process and developing discussion documents and questionnaires.

The team of provincial programme managers included:

- ◀ W Erasmus (Eastern Cape Province)
- ◀ TJ Ramanamana (Free State Province)
- ◀ M Mosifane (Gauteng Province)
- ◀ D Dlamini & Rev. S. Radebe (KwaZulu-Natal Province)
- ◀ ME Zwane (Limpopo Province)
- ◀ L de Beer (Mpumalanga Province)
- ◀ JCF Eksteen (Northern Cape Province)
- ◀ N Masigo (North West Province)
- ◀ B Saaiman (Western Cape Province)

A group of provincial researchers, each representing one of the provinces, contributed in the planning of the evaluation survey and in some cases assisted with fieldwork. These researchers included:

- ◀ S Nompozolo (Eastern Cape Province)
- ◀ TJ Masiteng (Free State Province)
- ◀ GJ Steyn (Gauteng Province)
- ◀ R Dladla (KwaZulu-Natal Province)
- ◀ MB Mashatola (Limpopo Province)
- ◀ JJ Mokoena (Mpumalanga Province)
- ◀ JCF Eksteen (Northern Cape Province)
- ◀ JB Stevens (North West Province)
- ◀ AJ Coetzee (Western Cape Province)

3.5 Project funding

The main funders of the project were the national Department of Agriculture and the Dutch Government. All the provinces did not use the funding allocated in 1999 for research into innovative ways of doing extension. The NDA lodged a request to the Dutch funders to allow these funds (interest accrued as well as the non-utilised funds) to be allocated for the new project.

It was money that accumulated on the basis of interest, because this funding has gone back a number of years, starting with the projects in the different provinces. And I only came back with the major study when it appeared that, will we get anything out of it? Will we be able to somehow get to an extension model, and obviously, then the NDA requested the Dutch government to allow the funding to be used for this project. (Gustav Düvel, interview, 10 November 2003).

3.6 Project outputs and deliverables

The project started in June 2001 and ended in December 2002. Two reports were produced - a Final Report in December 2002 and an Executive Report (recommendations from the Final Report) in 2003.

The first phase of the project consisted of the drafting of a new extension approach. These findings were implemented in the follow-on phase during which Prof Düvel conducted a series of provincial workshops.

3.7 Intellectual property

The issue of intellectual property ownership is not important to the Institute as the majority of the contractual work is completed for the NDA. Furthermore some projects are completed in collaboration with certain African countries through postgraduate students from these countries. Although universities, and therefore by implication the University of Pretoria, are becoming very serious about the knowledge outputs of research centres, this has not had an impact on the Institute of Agricultural Extension. Prof Düvel was negative when questioned about any income from royalties from research outputs:

No, no. That I don't know whether perhaps now with campus company that is going to look at intellectual property; we haven't had a sensitivity for that; we're probably not sufficiently commercially orientated. (Gustav Düvel, interview, 17 August 2000)

4 Mode of knowledge production

4.1 The participatory action research methodology

Prof Düvel realised that research procedures should be followed that involved all parties in such a way that the whole project, in terms of conceptualisation, process, recommendations and implementation thereof, would be owned by the extension staff in the provinces due to the sensitive issue of provincial responsibility and national prescriptions. It was clear to Prof Düvel that any prescriptive and "top down" method would not be accepted and would inhibit the implementation of a new extension approach in the provinces.

Prof Düvel communicated the scope and goal of the project to all provincial extension departmental managers and extended invitations to all concerned to become involved in the project. Provinces were requested to nominate representatives to attend the first workshop.

The key issue guiding the investigation was the participatory condition, implying the full involvement of the role players, in particular the nine provinces, i.e. the extension managers as well as frontline extension workers. And the way it was interpreted was of course by doing the project in a participatory manner, that people were involved; in other words, would get ownership, and then, automatically, this would lead towards the implementation, especially if clear guidelines are developed (Gustav Düvel, interview, 10 November 2003)

Prof Düvel received clear indications of the basis on which further collaboration would be possible. During the first national workshop at the end of 2001, opposition was expressed to the formulated project title: *Towards the development of an appropriate extension model for South Africa*. The provincial representatives were of the opinion that a “model” was too rigid, fixed, and even prescriptive. It was therefore decided that the project would work towards an *approach* to extension.

From the workshop emerged the consensus opinion that no rigid model, irrespective of its nature, is acceptable because the situations between and even within provinces vary too much. (Final Report, 2002:1)

We ultimately didn't come up with a model. Because a model is strict and inflexible and sort of a straight jacket for provinces. Now I think this was the positive thing about it that right from the beginning there, people were resisting. They would very hesitantly accept such a model. Because we know there is no best method [] And also to get the support of the provinces, it was very important that we went this way. So we have changed the model to an approach which is more flexible. (Gustav Düvel, interview, 10 November 2003)

A primary goal of the participatory approach is to involve as many of the stakeholders as possible. Prof Düvel decided not to involve the small-scale farmers but instead to work exclusively with the provincial extension staff. He reasoned that a more uniform theoretical base could be established in this way,

We did not involve clients, because, there the problem would have been even greater. The only way in which we involved, or the only issue where they were involved, was in the evaluation of the current service. In other words, did they find this acceptable? What was their opinion on the service? But to ask a client, I mean even many extension people couldn't answer the question about what should an appropriate approach to extension be, that would not have been possible. People argued that that should perhaps have been done. I feel little purpose in it because then you get opinions which are really based on ignorance. (Gustav Düvel, interview, 10 November 2003)

The small-scale farmers and representatives from rural communities were the end-users of the extension service and should therefore become part of the extension process at the service delivery level. The dilemma faced by the national extension service and highlighted by Prof Düvel is the huge need for rural development and capacity building through agriculture, on the one hand, and the limited resources to meet the need, on the other. This reality prompted him to formulate the so-called “priority” approach:

A priority approach is essential in extension in South Africa given, on the one hand, the overwhelming task and challenge in agricultural and rural development and, on the other hand, the limited resources. The variety of needs, levels of development and available resources in South Africa are such that a very focused or one-sided understanding and approach cannot be afforded. However, the emphasis should clearly be on the capacity building side, but allowing for a mix that meets situation specific needs and circumstances. (Düvel 2003)

The “situation-specific” aspect of extension aims to address the reality that communities’ needs are not necessarily the same but that the approach should allow for particular areas of need to be expressed. By following this approach, it is hoped that resources could be allocated more wisely and real needs addressed.

Implications for project management

In choosing a participatory action research methodology, definite advantages and disadvantages had to be taken into account. Elaborating on the pros and cons of such a methodology, the project leader indicated some of the advantages and disadvantages (Gustav Düvel, interview, 10 November 2003):

- ◀ Advantages include the close or involved way in which Prof Düvel and provincial representatives collaborated at the various stages of the project, namely brainstorming new ideas based on provincial experiences, constructing questionnaires, disseminating progress on provincial level down to extension staff, and obtaining the ownership of all parties involved in the process.
- ◀ Disadvantages included matching a dynamic (participatory) approach to a rigid and fixed structure such as a tender procedure requiring a clearly defined outcome or report which is in essence not the nature of the participatory dynamic. When a prescriptive approach is used a report would lead to a policy document, which in turn would become the “law” for extension practice nationally, whereas the participatory approach also influences the way that implementation would take place in that provinces would determine the pace and the priority of implementing the different recommendations.

A challenge of the participatory approach, is to keep the momentum going and engage all parties so that they would stay committed for the duration of the project, participate in a meaningful way through their inputs and contributions and, attend the workshops.

The obvious reason that is often given is that they haven't got the time, they would for example, in some provinces I got the head of the department for half of the time, and then he would have to leave. (Gustav Düvel, interviewed, 2003)

Because at many instances he had to motivate for postponements of target dates. And would contact us and say, we cannot meet in June, we have to meet in September. And as I have already said, maybe I shouldn't say it, but some of the workshops were poorly attended. Some provinces just did not pitch up. And then we carried on. We carried on without them. We couldn't stall the process. (Ben Saaiman, interview, 13 November 2003)

4.2 Phases in the development of the project

Figure 1 provides a snapshot of the various phases in the project.

Figure 1: Stages in the development of the agricultural extension project



First phase: National workshop

It was imperative that representatives from the provinces to the national workshop should have credibility and good standing within the provinces. The size of representation (from provincial groups) and attendance of all workshops were important to the credible progression of the project.

The nine provinces were invited to send a delegation of about ten representatives to the national workshop. The request was that the delegation should at least include a broad spectrum of senior and middle management, and front line personnel. The delegation could also include representatives from non-governmental organisations in agriculture, farmer organisations and higher education institutions.

The workshop attendance varied from province to province – from 100% to 30% in some cases. Top management, heads of department, etc. were difficult to involve due to busy schedules.

Delegates were requested to bring their ideas and expectations on extension to the national workshop. In particular, the Dutch-funded project on alternative ways of doing extension that was undertaken in some provinces in 1998/9, formed an important background and stimulated perspectives and inputs on extension. It was the primary goal of the workshop to gather ideas and suggestions on extension from as many representatives as possible. Particular group techniques, such as small group discussions were used to draw up a list of extension principles:

The methods used within the group sessions involved nominal group techniques to ensure that no potential contributions were overlooked or overruled. This was invariably followed by Delphi procedures to facilitate interaction and the possibility for participants to associate themselves with viewpoints they believed to be the best founded. (Düvel 2002, 1).

An important aspect that would impact on the level of argumentation and presentations at the various workshops was the assessment of extension training/theoretical base and experience. It was imperative to work from the same base. Discussions of the theoretical base for extension and strong leadership were therefore very important.

You have a head of a department who very often knows less about extension than his subordinate. There is huge sensitivity, you know. (Gustav Düvel, interview, 10 November 2003)

Mapping the theoretical depth of representatives' knowledge on extension was done by presenting them with alternative interpretations within particular approaches and principles and requesting their views on it.

I think what was in our favour was the fact that the issue was well known. In other words, many people had their views on extension. But if you question them on certain approaches and principles, then [] so the approach we used was basically that we identified alternatives within certain principles. And then got their views on which of these they would support. So, it was in a way already a closed end type of research. It was not every time opening up the world, but rather on these alternatives, which would you support and why? (Gustav Düvel, interview, 10 November 2003)

The workshop concluded with a wide array of principles expressing the views and the particular contexts of delegates from all the provinces. These principles formed the basis of the series of workshops for the provincial programme managers.

Second phase: Provincial programme managers' workgroup

The process aimed to conceptualise the extension principles to draft a discussion document. The discussion document would be discussed at workshops on provincial level.

The principles were refined into categories and was discussed at further follow-up meetings by the workgroup of provincial programme managers. This group, led by Prof Düvel met regularly and proceeded to conceptualise these principles, and identified various alternatives within each of the principles. A discussion document was formulated for further discussions on provincial level.

Third phase: Provincial workshops

The provincial workshops were conducted to reflect on the extension principles contained in the discussion document. The provinces would have to take ownership of the selected principles on this level, with the eventual aim of implementing it in their context. The national programme manager, Prof Düvel, held meetings with provincial management teams in order to win their understanding and support. A series of workshops were consequently held on regional and district level where extension staff could express their views and preferences on the principles contained in the discussion document. The discussion document was firstly discussed at the workshops to invite questions from extension staff. Prof Düvel could then answer these questions; explain the process up to that point and how the principles were taken up into the discussion document. After the group session and open discussions, participants were requested to indicate their preference for the principles by filling in a questionnaire or discussion form. The completed forms were sent from provincial offices to the project office to be processed and analysed for the final report. High attendance from provinces showed positive signs of buy-in and ownership of the whole process.

Approximately 40 percent of all extension personnel were involved in the group discussions, which is an extremely high representation, making it one of the most extensive surveys ever to be conducted among extension personnel in South Africa. In some cases (Northern Cape and Gauteng) the total extension staff were involved and Gauteng even invited a significant

number of personnel from other sections only indirectly concerned with extension. The smallest sample was in Limpopo, but even there the fact that 324 extensionists participated, reflects tremendous support. The same applies to the other provinces and is highly appreciated. Problems experienced were in terms of the timely response, which resulted in the survey lasting from April to November 2002, while some data was only received at the end of December 2002, and is still outstanding. In the majority of cases there was no selection of staff. Normally the staff followed instructions and attended the group sessions, unless it was not possible due to other commitments. In the Eastern Cape and KwaZulu-Natal the participants were seriously restricted due to the limited availability of transport, which very often resulted in more senior personnel being better represented. (Düvel 2002)

Prof Düvel facilitated most of the provincial workshops that took place between April and mid-November 2002. Assistance by provincial programme managers and researchers were usually limited, as they lacked the necessary background, and requested at least two sessions as observers in order to acquire the necessary knowledge and confidence.

Prof Düvel had preliminary discussions with extension managers to improve clarity and understanding of the principles in the discussion document. They in turn, would explain the meaning of principles in cases where it was not understood.

Group interviews were conducted in such a way that every participant was given a discussion form or questionnaire for completion. They were informed about the purpose of the exercise, mainly to get a feedback from extension staff regarding their own personal viewpoints. It was, therefore, emphasised that there were no right or wrong answers and respondents were encouraged to give their honest opinion. Emphasis was, nonetheless, placed on informed opinions. This was accomplished by the facilitator providing the necessary background reasoning and explanation and pointing out the pros and cons and also the implications of many of the alternatives within the principles, and by allowing as much interaction and exchange of viewpoints between the participants as possible. However, the latter had to be restricted, because of limited time available, since the group sessions took anything from six to eight hours or even longer. (Düvel 2002)

The most important output of the workshops were the completed questionnaires. It was clear from the responses that the level of extension knowledge and understanding of the principles were overestimated.

Special care was taken during the group interview sessions to ensure that respondents understood the issues and knew how to fill in the information. However, in spite of these efforts, and also the use of a data projector for demonstration and further clarification purposes, the obvious misunderstanding resulted in a relatively large number of missing values. A lot of time had to be spent controlling and cleansing the data during and after capturing on computer (spread sheets). In general the knowledge background and understanding of respondents was

overestimated, which does not auger well for the ability and quality of extension staff and, of course, impacted negatively on the reliability of the data. (Final Report 2002)

Table I shows the attendance figures for extension staff at the provincial workshops.

Table I: Attendance at provincial workshops

Province	Extension staff	Staff attendance	Sample %
Eastern Cape	674	229	34
Free State	125	55	44
Gauteng	53	53	100
KwaZulu-Natal	568	193	34
Limpopo	1118	324	29
Mpumalanga	154	129	84
Northern Cape	22	22	100
North West	309	173	56
Western Cape	39	21	54
TOTAL	2998	1199	40

Source: Table 1.1 (Final report 2002:3)

Drafting of final report and recommendations

Prof Düvel drafted the final report, with specific recommendations, incorporating feedback from the provinces. The recommendations in the final report were the result of a participatory process and therefore implied that provinces were obligated to implement their collaborative ideas.

So what we ultimately did, and this was the last phase of the research when we had written the report, made the recommendation, went back to the provinces to get feedback as to, these now are the recommendations, what do you say? And that again, varied quite a lot. In most cases I got about 20 to 30 of the middle and top management. I started off with one or two provinces where I presented them with the recommendations and asked their response. And this was very difficult to capture, because some individuals would talk, the others wouldn't talk, they would invariably ask questions, make contributions, in other words, at the end of the day I really had nothing. I couldn't capture their responses. So, what I then did was, again in terms of a questionnaire that I said, this is the proposal. Do you support it or not, or are you neutral about it? In other words we tried to discuss, what does the problem say? And then in most cases they would discuss it and they will say, yes, we as a province favour that. Everybody would, in some cases where this didn't happen, I had the individual responses. So I now have for the recommendations, I can say, that province

support it to 75% or whatever the case may be. Well, I would say, one conclusion one could draw would be that the recommendations made, although they are fairly far-reaching and are revolutionary in many regards, found a lot of support. And another thing one could, there are sometimes differences between provinces, but I was amazed at the level of consensus that did come out. (Gustav Düvel, interview, 10 November 2003)

Project continuation – towards Implementation⁴

The national Department and implementation: Prof Düvel expressed frustration with the project process that had come to a halt at the time of the interview (10 November 2003),. Official approval was needed in order to publish the report and make it public to various stakeholders. The final report was handed to the NDA in December 2002. A year after the report had been submitted, official approval was still pending with the result that a moratorium on the report was still in effect.

The problem is still the moratorium. The report has still not been OK'd for publication. I've tried again and again to get this [] but nobody seems to be taking a decision. There has been one presentation and publication, the [European Union] Extension Seminar. And another one will now be during May in America. [] That is just a matter of, it is now a new division, nobody wants to take the decision. There is nothing sensitive about it, except that it sort of reflects pretty negatively on how bad things are. (Gustav Düvel, interview, 10 November 2003)

Implementation was part of the original terms of reference. It was perceived that the participatory research method would automatically lead to implementation all stakeholders were involved, particularly if the guidelines were clear.

Some of the recommendations were very specific, such as the establishment of working groups in the different provinces to implement the different programmes, and thus the importance of a well-managed implementation process became more evident:

Five programmes were proposed, and then the need existed to, but who is going to implement this, who is going to drive this? There is nobody at [the national level] who can and who is in a good managing position. And this then gave rise to, well, you can say the tender was extended, but factually in terms of the administrative part of it and the logic of it, it ultimately boils down to a new tender that would take the implementation phase a little further. (Gustav Düvel, interview, 10 November 2003)

One of the factors that complicated the process was the departmental restructuring at the NDA.

[The project] was housed within a certain section of the Department, namely it fell under Education and Training. And in the last two or three months there has been a change and it now falls under another chief directorate which is Research and Technology Development. The

⁴ See Appendix 1 for the project recommendations.

implications now are that you now have a new chief director and he has got a different perspective. (Gustav Düvel, interview, 10 November 2003)

A national workshop was proposed for November or December 2003 to officially launch the approach. This would, according to Prof Düvel, have more publicity value than real advantages towards implementation.

What the final stage of this extended project would have been is a national workshop. And that has been postponed if not cancelled completely. The ideal was that it would take place later. I don't see the purpose of such a workshop, possibly from a publicity point of view it could have some value. I'd rather use that money to get these programmes started. (Gustav Düvel, interview, 10 November 2003)

Provinces were informed about the national workshop. The idea was that the NDA would clarify the way forward. After the postponement of the workshop, the project manager, Prof Düvel, personally communicated with the provincial programme managers, and requested from the new chief director to get a communication out to the provinces, informing them about this postponement. The continuation of the whole process is in the hands of the NDA.

The situation with regard to the lack of decision on the status or continuation of the project has not changed since the November interview. Prof Düvel expressed his frustration again :

It is not going well with the project, because the national Department of Agriculture is dragging its feet and cannot or will not take decisions. (translated from Afrikaans: Düvel, email, 21 April 2004)

Provinces and implementation:

There is nothing preventing any province now with implementation. (Gustav Düvel, interview, 10 November 2003)

All participating parties were aware of the contents and the implications of the extension principles. Provinces were told the recommendations could, unofficially, be implemented.

Of course this is what we now envisage with the different programmes that are now being launched in the different provinces. Where the provinces basically now have to, they are confronted with these proposals, let's say on a programme like evaluation and monitoring. These are the proposals, we in our province, which of these do we accept, how do we implement it, what additions do we make? In other words, they are challenged and forced to now launch programmes in this regard on the five different major programmes which capture the different recommendations. Basically categorise them into five programmes. (Gustav Düvel, interview, 10 November 2003)

Implementation varied from province to province. Management capacity and resource availability impacted on provinces' ability to implement the recommendations. The size differences in extension services in the provinces also impacted on implementation. Some

are relatively small, such as the Western Cape; while others are much bigger (Limpopo) and therefore implementation would be negatively influenced.

I was last week in KwaZulu-Natal; they have now nominated the members of the different programmes or working groups, but obviously, now need to be urged to go further. And this is where this champion co-ordinator is important. For example, I would love to now get names from the different provinces and organise the first workshop on, for example, monitoring and evaluation. Exactly how do we move forward? For example, Western Cape, they are well ahead. If it is taken seriously by the top managers, but even, if not, to bypass them towards the provinces. (Gustav Düvel, interview, 10 November 2003)

Monitoring and evaluation: The fifth recommendation, namely monitoring and evaluation, would determine the progress of each province's implementation of the five programmes. The internal evaluation would provide assessment and benchmarking with the other provinces, therefore having a positive impact on implementation progress. This would provide the basis of discussion and interaction between provinces, and between provinces and the NDA.

We have given them in the policy certain guidelines, for example, we need to not only evaluate the broad spectrum of the programme, but we need to evaluate over a wide spectrum as possible. We need to go rather to a maximum of evidence and a minimum of evidence for certain things. These guidelines are there. Now, how the provinces will implement that, that obviously rests with them. But again, the provision that has been made in the proposal is that these working groups in the provinces, there the provincial co-ordinator will link up with the national co-ordinator, it is supposed that I do that in the mean time, but that [makes provision for] the different provinces linking with each other, in other words, comparing notes, what they have already put in place, the other people could also use that so different ideas are available. (Gustav Düvel, interview, 10 November 2003)

Policy formulation: The formulation of a national policy is still outstanding and would make up the output of the last phase towards the completion of the project.

The one sort of implementable thing will be the policy document that will emerge from this, and this is probably the last phase with which I'm involved now. I probably still have to write that policy document which will then be the guiding document for the Department probably for the next five years. (Gustav Düvel, interview, 10 November 2003)

Policy formulation would not be strict and dogmatic policies regulating the actions of extension services in the provinces. The participatory method implied that the various stakeholders had been involved in brain storming, the conceptualisation of the extension principles, and the recommendations were discussed at workshops in the various provinces. Therefore, the content of the final report were the results of a collaborative process. The representatives from provinces expressed their opposition from the start against any strict and prescriptive model that would negate the specific nature of

agriculture, and therefore of extension needs, in the provinces. The collaborative process and input from all role players contributed largely to the contents of a policy-in-making.

And I think in the formulation it would probably be facts that in some cases it will be more unspecific, but it would still serve the purpose of having a sort of a framework that, number one, allows for everybody to feel comfortable in, and at the same time it would still serve the purpose of giving direction. (Gustav Düvel, interview, 10 November 2003)

The policy phase, as is the case with the managed implementation of the recommendations, has come to a halt because no decisions have been taken by the NDA.

Despite this, Prof Düvel remains very positive that the research aims were achieved, and that that the eventual impact of the extension approach would be very significant.

5 Mode of knowledge utilisation

5.1 The utilisation context

According to Prof Düvel, the Western Cape had advanced furthest in terms of implementing the recommendations and would be the most obvious user of the research. A brief overview of the Western Cape Department of Agriculture and its extension activities, and the agricultural profile of the province are provided is therefore provided.

A short history of the Western Cape Department of Agriculture

Elsenburg is the head office of the Department of Agriculture in the Western Cape. It is an important centre both for education and the delivery of vital agricultural services, and has a long and colourful history spanning more than three centuries.

Elsenburg was named after Samuel Elsevier, who was seconded by the governors Simon van der Stel and his son, Willem Adriaan at the Cape during the 1690s. The first land grant to Elsevier was in 1698 when Simon van der Stel allocated 110 morgen⁵ to him. A further 70 morgen followed in 1701 from Willem Adriaan. After a social revolt aimed at the agricultural practices by which Willem Adriaan van der Stel and his officials monopolised farming and trading with the various ships berthing at the Cape for fresh rations, he was banned in 1708 with the governor and some other officials. The farm was sold after his deportation. Since then various owners owned it until 1752 when Martin Melck bought it (Elsenburg Ontwikkelingsprojek, 4).

Martin Melck was a visionary and very successful farmer, and designed the homestead and farm into a model for the region. It became the biggest agricultural business in the Cape during the eighteenth century. The farm had a stable water source and the main products were wheat, wine and livestock. A small school for slave children was established on the farm. The farm belonged to some influential people in the farming community after Martin Melck sold it including, Piet Retief, the later leader of the *Voortrekkers*⁶, was well known. In 1898 the Cape government bought the farm to establish an agricultural college.

⁵ A "morgen" is a South African unit of area, equal to about two acres or 0.8 hectare.

⁶ The *Voortrekkers* formed part of the migratory movement of mainly farmers leaving the Cape for the South African interior in 1836.

Many “firsts” in the country in the area of agriculture were initiated at Elsenburg. These included, amongst others:

- ↳ the establishment of the first agricultural college, the oldest institution for agricultural education in Africa (1898);
- ↳ groundbreaking research in the cultivation of deciduous fruit (1899);
- ↳ the establishment of the Research Institute for Viticulture (1914);
- ↳ instrumental in the establishment of the first Faculty for Agriculture in South Africa at the University of Stellenbosch (1917);
- ↳ research into soil types, fertiliser programmes, dairy farming (first Friesians registered in 1906,
- ↳ first artificial insemination in 1947),
- ↳ indigenous wheat varieties as well as pest control; and,
- ↳ the establishment of kikuyu grass (1917) as important fodder-crop for livestock on controlled pastures (Elsenburg as katalisator vir Landbou-ontwikkeling, 3).

The three departments of agriculture functioning in the Western Cape (coloured, Indian and white) amalgamated into the Western Cape Department of Agriculture on the 1st of April 1993. The (coloured) Agricultural College Kromme Rhee was closed down and amalgamated with the College at Elsenburg.

Agricultural profile of the Western Cape province

The Western Cape has a diverse climate with a rainfall of more than 2000mm in certain areas to less than 150mm per annum in others. The variation in rainfall and soil types contribute to the wide variety of crops grown in the province (Information brochure, Western Cape Department of Agriculture). Of the approximate 13 million hectares, 3 million are cultivated and approximately 270 000 irrigated. Main products are wine, deciduous fruit, citrus, grain, vegetables, ostriches, small and large life stock, and dairy products. The geographical area of the Western Cape is divided into five management areas consisting of the Boland, Swartland, North West, South Coast and Little Karoo. Extension offices and agricultural development centres are spread through these regions. Various experimental farms are located in these areas to assist with focused research and extension.

Extension in the Western Cape Department of Agriculture

Extension services in the WCDA fall under the directorate Technology Development and Transfer. The sub-directorates of Animal breeding, Crops, Agricultural Economics and Extension Services form part of this directorate. Extension services endeavour to address various aspects of developmental problems, technology-related information, demonstration of technology in context, and forge links with various stakeholders in the development sphere. Significant changes have taken place during the last decade in the focus of the extension services with the result that almost eighty percent of the service is now involved with developmental agriculture and small-scale farming communities.

Mr Saaiman headed the task team, established in 1993, to study small-scale farming.

We did quite a comprehensive study on small-scale farming areas in the Western Cape. It was a study on knowledge, perceptions of small-scale farmers, and how we as Department should adapt to provide services to them. But it was a totally different ball game to white commercial farming. Subsistent, poor people, from an extension perspective it was something totally different. Even the best advice, if a person cannot afford the advice, then it is worth nothing. So, it was basically to reflect on how the Department should adapt and change its programmes to assist small-scale farmers. (Ben Saaiman, interviewed 2003)

Box I: Aims and objectives of the Western Cape Department of Agriculture's Extension Services

"The aim of our Extension Services is to promote sustainable agricultural systems within the Western Cape in order to ensure prosperous farming communities and rural livelihoods. Our objectives include:

- To identify and prioritise agricultural development problems in conjunction with farming communities.
- To transfer proven and applicable agricultural technology and information to farming communities on an ongoing basis.
- To evaluate and demonstrate proven agricultural technology under local conditions with farming communities.
- To identify production, development and marketing opportunities for farming communities.
- To engage in capacity building and organisational development within mostly developing farming communities.
- To promote cooperation and coordination with other stakeholders within the development sphere."

Source: WCDA web site

The change in focus is reflected the allocated time to serve the small-scale farming community. In the Western Cape, the current ratio of services for commercial versus small-scale farmers is about 40/60. The balance of service to commercial and small-scale farmers varies in the different provinces. Nationally, in most provinces, extension services to commercial farmers have virtually ended.

In this province we have a policy as well and we try to do both. The staff asked me to have it written down, what is the percentage, and roughly forty percent of our effort goes to commercial farmers. Sixty percent to small-scale farmers. So it has gone over the fifty percent mark. We have future plans that would shift it even more. Personally, I don't believe and I don't think it should go to a hundred/zero. The philosophy is that in land reform, we're getting more and more involved in land reform with extension support to new entrants. You want to take new entrant small-scale farmers, make them stronger and eventually make them commercial farmers. Then you [would] know nothing about commercial farming and how to lead them. So

we believe in a different philosophy that we should keep on serving commercial farmers, maybe scaled down but have a very focussed small core group that still work with commercial farmers, so that we can lead people there. How can you be their advisor if you know nothing about that level of agriculture? But the 40/60 would probably change towards 30/70 over time, probably 25/75, but not below that. We will probably end up with about a quarter of our time focussing on commercial. (Ben Saaiman, interview, 13 November 2003)

The shift in extension focus is reflected in the most recent restructuring of the WCDA (January 2004). The previous focus on programmes was replaced by a regional approach and more particularly a service provision approach. A new sub-directorate, Farmer Support and Development, was established replacing the previous programme for extension services. The rationale behind the restructuring is to provide a package of service provision focused on each of the five regions.

Mr Saaiman heads a team of approximately 100 to 120 staff members focusing on five functions in the Boland area. The previous sub-directorate Technology Transfer has been taken up as only one of the five functions. It is also expected that staff would be able to deliver services in five function areas. Agricultural extension is no longer functioning as a focus area on its own.

The five functions incorporated into the new programme are:

- (1) Agricultural extension
- (2) Land reform
- (3) Infrastructure establishment
- (4) This function focuses specifically on small farmers where infrastructure (irrigation, buildings, etc.) is lacking. It also incorporates an engineering component.
- (5) Food security
- (6) This function will be linked to the work done by social services. About 20 000 people receive food parcels in the Western Cape. It is envisaged that this function will contribute towards capacity-building and helping people, on a micro scale, to generate their own food (small backyard gardens, chickens, etc.).
- (7) Capacity-building and/or institutional support
- (8) This function focuses on the establishment of institutional bodies, such as farmer societies, in rural (developmental) farming areas. Life skills and other training is linked to this.

Service provision will be rendered on three different levels, namely:

- (1) Subject specialists (qualification requirements: degree in agriculture)
- (2) Agricultural technicians (now agricultural development officer) (qualification requirement: Junior National diploma), and
- (3) Agricultural community worker. This new position was created the completion of a project by the Institute of Agricultural Extension on an appropriate extension approach. The community worker will be expected to convey practical skills e.g. how to plough, etc. The qualification requirements are a Senior Certificate (matric) and short courses in agriculture.

Dynamics in the national and provincial Departments of Agriculture

The relationship between the national and provincial Departments of Agriculture does not seem to be clearly defined. Provinces do not regard extension services as an important daily task.

I know in certain instances there might be a lot of tensions. As far as extension is concerned, and that is my honest answer, I don't know of the existence of national. If you ask me now, who has the portfolio of extension and support services at [the national level], I don't know. I don't know a name or a face, I get nothing from them, I don't talk to them, I don't send them anything, we do our own thing. Which, in a sense is bad actually. To put it very bluntly, we don't want interference and sort of big brother looking over the shoulder and tapping you on the knuckles, we don't want that, but surely, a national department which has to look at the country, must have a role to play. At the moment, in my opinion, they are not playing any role. I mean, I have no interaction with them, I don't get any guidance, we get nothing in terms of extension. I don't know about the other disciplines. And in terms of extension, this was the closest to it. But it was driven very heavily by Prof Düvel. There was always someone from national there, one or two people, but they change a lot as well. We would just meet someone, and at the third meeting there would be somebody totally different. [] I describe it as a portfolio or a vision or whatever. They didn't have a dedicated group of people saying, we deal with extension issues. Like the province for instance. We have a division. I am head of a division with staff and a budget who work with extension. No, obviously national cannot have such a division because they don't service farmers, they don't have farmers as clients. But they have provincial departments as clients and there probably must be a core group of maybe two or three people, saying, look, the whole issue of extension and this report and how it is implemented. Someone has to look at this. So, with a long story to get back to your question, there is no interaction. So it's not like I have any tension with them. We don't interact with them. I don't have a name there. I don't call, I don't correspond, nothing. We're out here on our own. (Ben Saaiman, interview, 13 November 2003)

It was evident that Prof Düvel was driving the process and not dedicated extension specialists at the national level although provincial participation were invited from the national department. The relationship between the national and provincial departments prompts the important question: How will a policy directive from the NDA be structured methodologically so that provinces would partake in its drafting process and own it?

5.2 The participatory process: A client (utilisation) perspective

Pre-project research on extension

During 1999, research funds from the Dutch government were allocated to the provinces to evaluate new or innovative ways of doing extension. They had already experienced privatisation in the Dutch extension services, and wanted to stimulate new thinking on agricultural extension in South Africa. The WCDA used the funding to test various new

approaches that would not have been possible under the established programmes and budgetary constraints.

The brief was innovative ways of doing extension and we could be innovative and put anything in terms of a project on the table. We ended up with three or four different [extension projects that were] defined fairly wide. And we also included training under it as well. So the college downstairs, I think they ran one project, and we ran three. One of them was sort of seconding staff to an NGO, which was never done in government. In government you work with government officials, so we actually took two of our extension officers and we gave them away. We gave one guy to an NGO, we gave the other guy to a community-based organisation, practically a farmers' association. We said, you are farmers, you are well organised, you have an organisation, we give you an extension officer. You can have him for free. We will pay his salary and his running costs, he is put in your service. And we wanted to see if he would actually be delivering a better service if he worked directly under the control of the client. I mean, the client is now his boss, not the Department. In the other case, the person worked for an NGO which was much more flexible than government. NGOs operate like the private sector. If you want to buy something, you do not need to get permission from all the sources where we need to get it. (Ben Saaiman, interview, 13 November 2003)

The research into new approaches continued during 1999 and 2000. The results from the research would form an important element of the national Workshop that was organised and held in Midrand (Johannesburg) during October/November 2001 to launch the project, "Towards an appropriate extension approach for South Africa".

We were invited to a workshop in Midrand in Johannesburg organised by basically Prof Düvel and the national Department. It was my understanding that the NDA actually funded this. Prof Düvel was appointed as study leader. That was the starting point saying, hopefully you've learnt lessons from the Dutch funding, you've learnt a lot of lessons, bring that to the table because we are working on an appropriate approach. [] So that first workshop was basically a report back. I had a power point presentation. We reported back on the full project that we did. Lessons learnt, what worked, what didn't work. Suggestions, whatever. Four provinces did that and, as it was explained to us, all of that knowledge would be going into this project to get the new approach rolling. (Ben Saaiman, interview, 13 November 2003)

The national workshop (Midrand): Forging a collaborative research method
Provinces received invitations to the national workshop in Midrand. From the first briefs on the project, it was not clear what the research method would be, and perceptions were that a rigid or prescriptive methodology of drafting an extension model might be followed. This would be difficult to accept for provinces since they were, according to the Constitution, responsible for decision-making at provincial level.

Right in the beginning, I think, the national Department has just contracted Prof to do what they wanted him to do, the national Department in a sense and Prof Düvel as well, had decide to have a national policy. At

that stage it was said, we want to build a new extension policy for South Africa, this is how it will be. And on that, that was right in the beginning, we disagreed. We were not on the same wavelength. (Ben Saaiman, interview, 13 November 2003)

The boundaries of national and provincial responsibility regarding agriculture, but more specifically extension services, were brought to the centre of the discussion early in the workshop. Provinces were adamant that agricultural conditions differ too much provincially to be regulated by one strict national policy. However, it was acknowledged that a broad approach should be formulated to regulate extension.

Yes, we were unanimous on this, the nine provinces said, if you want to sit down and write a national policy and enforce it on us, don't count us in, we'll work on our own. We heavily disagreed on that and then they said, listen you don't have a free for all, you cannot do whatever you want, there must be some guidelines, some approach. And we said, no, sure, I cannot do whatever I want down in the Western Cape, I have to fit into a broad idea about how do we do things in South Africa. It is going to be different to what we do in Kenya. But accepting that the Western Cape is different to Limpopo, and once we've sold that idea and all nine provinces said that, I think then the thing started going into a specific direction. [] and then the wording was changed from 'policy' to 'approach'. And all of us said, we are fine with a sort of, not too wide, but guidelines of how the job should be done. [] And then, this is what I started saying, I saw ourselves as a sort of a work group. Prof Düvel was to stay on as leader but he couldn't, or shouldn't go the way all around saying, look I designed a new approach without provinces' involvement. But he did involve provinces and we had to nominate someone. I represented Western Cape and we had regular meetings. (Ben Saaiman, interview, 13 November 2003)

Creating an even base of theoretical understanding

The different levels of academic education and training amongst extension staff could potentially have a negative impact on the research process, because a common basis on for the participatory process did not exist. On a personal level, some representatives could lack confidence to freely take part in the participatory process and group discussions. Differences in the theoretical framework may lead to miscommunication between representatives and therefore impact negatively on the methodology and progress of the research process. Therefore, Prof Düvel conveyed important theoretical knowledge at various events to construct a general theoretical base for extension thinking and the focused contribution by representatives. Mr Saaiman explained this as follows:

Do the extensionists actually understand the theory of extension? Many of them are new in this field and did not have, like myself, extension training. They do extension, but they maybe got a diploma or a certificate in technical agriculture but they've never done the human side of it. [] We had many sessions, workshops, we had two provincial workshops, quite a few national workshops which Prof had to organise and present. And during the workshops, I mean, there was a lot of explaining of the principles of extension and the theory. You could define that as training, but there

wasn't any specific training session, a formal training session. But the workshops had a lot of training in them as well. [] We've had lengthy discussions and interpretations of certain theoretical things, and Prof, as an academic, would go into this. We would have quotes and he really bombarded us with theory. And we entered into debates and could say, yes, but this was not the way we see it, and that was excellent to refresh oneself on the core basis of extension theory. [] Some of the provincial people felt [] that Prof Düvel is now really getting very academic and influencing us too much. We know he should be influencing us from the theory's side and we should build this thing on theory. But some of them felt, look; he is pressing his own ideas too much. And I never got that impression. I was quite comfortable. (Ben Saaiman, interview, 13 November 2003)

Workshop dynamics

A wide spectrum of interested parties was invited to the first workshop. Small-scale farmers or clients were not invited as they would make no practical contribution.

The first workshop in Midrand where we started, there were provincial officers, departmental staff as well as let's say other service providers that we have invited. For instance, from this province, André Coetzee also went out there, he's a lecturer at Cape Technikon, he teaches extension. So, as a sort of an academic, he was invited. There were people from NGOs, there were people from the Agricultural Research Council [] NGOs dealing with small-scale farmers, giving assistance to small-scale farmers, extension, training courses, whatever. There weren't really farmers there. (Ben Saaiman, interview, 13 November 2003)

The size of the Western Cape delegation was limited by costs and included twenty people.

From the national workshop to a discussion document

The provinces introduced various perspectives that had to be categorised, linked to extension principles and drafted into a discussion document. The central principles were identified and questionnaires were sent to provinces to ascertain their views. Prof Düvel requested the nine provincial extension managers to form extension managers' workgroups to draft the discussion document and questionnaire.

So the workgroups designed a questionnaire which is in this report. It was not merely a questionnaire, it was like a statement/question type of thing saying, this is the principle, and then asking the question, how do you understand [the statement], can you agree with it, can you live with it, should it be incorporated into a model, etc? So it was giving people a lot of statements and then asking questions on it. And I think we spent most of our time on that, designing that thing, and then, eventually, doing a survey, bringing it to the province, interviewing staff, having questionnaires, etc. (Ben Saaiman, interview, 13 November 2003)

Back to the provinces

The extension staff of the Western Cape extension service were involved during the project process.

Here we included everyone since we are only 43. I think at that stage we were 38. We got them together for a workshop and top people actually did attend this. These were just in the group not individual interviews. We actually went through the thing after dealing with the questions and asked, does everyone understand the questions? Then we asked them to answer the questions on their own. There was a group interview type of thing. That was then taken back and reworked and statistically [analysed]. And then we had a second workshop where we actually presented the answers from the group. We said, OK, this is what we said. Do we understand you correctly, is this what you actually meant? And then we sort of refined the answers again and that actually went back to the final report. So, we had two provincial workshops. I think it was done similarly in all other provinces. (Ben Saaiman, interview, 13 November 2003)

Prof Düvel presented the discussion document at a workshop of the Western Cape extension staff to explain the recommendations to them.

And as far as the report is concerned, Prof came down here for a workshop with all our staff, we had everyone there, all 40 of us. And we worked through this thing. He was well prepared, he had his power point and he explained. Once again explained to such an extent that people were feeling, we're getting a lecture in extension theory. But he made a lot of effort explaining the background of this and [] he could have just said, there are the recommendations, but he went five steps back and said, where was this recommendation actually born, what is the theoretical arguing of it, how does it fit practically into what we have recommend? A lot of explaining, which I think was excellent from his side. From the theory, using us as well saying, you people were part of the past, you brought the practical side to the table, and this is how we ended up with the recommendation. I think that was good. (Ben Saaiman, interview, 13 November 2003)

Prof Düvel received the questionnaires containing their views on the recommendations. The questionnaires were not completed within the timeframe by all the provinces and could therefore not be incorporated into the final report.

The Final Executive Report and provincial implementation

The extension managers' workgroup contributed towards the drafting of the final report. A list of recommendations emerged from the analysed questionnaires and were edited to present an implementable framework to the provinces.

Prof presented us with the final draft report and we had a workshop on that. Specifically the recommendations, I mean, the report is just a feedback of everything that was gathered. This whole thick thing was just giving back provincial data. The executive report is the one we actually made after this. This was presented at that workshop, with very broad recommendations. [] We felt that we would like the final draft. We said,

look, Prof, it's fine. We're not going to change the contents of it, but to make it practical for provinces, mould this into programmes. And this is where this executive report was drafted. It still had recommendations, but Prof routed them into these five proposed programmes. So, for all provinces to really take the recommendations on board, you need to have a programme on project planning. Because you work on projects and you need to have excellent projects, which are well planned, based on the theory of extension, and then, the list of all the recommendations. So, this thing to me is extremely valuable and we could actually sell this and not the massive report, to our staff. You do not have to work through the report. And as a management, we took this and ended up with this document. (Ben Saaiman, interview, 13 November 2003)

Western Cape implementation

Provinces were requested to start implementing before the Final Report was officially approved. The final recommendations were well-known and understood by provinces as it was part of the collaborative process.

And then, it was actually said, look, you said you are comfortable (with the principles) and now you have to implement this. You cannot shy away from this. This was actually what you wanted. This was the whole game or game plan, if you can call it that, to get something in, link it and marry it to the theory, and then present it as an approach. Okay, this is where we ended up at the end of 2002 with the report. At the second workshop, I can't remember the date, but it was probably in August/September, [] Prof Düvel, via national requested that we should move forward with implementation. (Ben Saaiman, interview, 13 November 2003)

The request for implementation was not interpreted as an officious summons from the national department but as an opportunity to express their perspectives. The recommendations were discussed provincially to draft an implementation action plan.

The report is there, we've had our feedback workshop, everyone is more or less happy, we had buy-in, myself I had four regional managers, so the five of us, we worked through this with Prof Düvel, and the request was now, sort of design your implementation plan on this. And this is what I've got here. There were a lot of recommendations and we had to sit down with each one of them. [] There were five programmes, suggested programmes with the purpose of each, and then specific recommendations, what needs to be implemented. And we had then to decide on action and say look, we accept this one, we accept this recommendation, this is what we intend to do and a target date. And some of them, if you page through this, you will see we did actually not accept. There is probably just one or two of them. (Ben Saaiman, interview, 13 November 2003)

Implementation in the Western Cape went smoothly because most were already in place and part of standard practice. It was necessary from a management perspective, however, to consider the total action plan covering the five programmes.

Now, I'm patting ourselves on the shoulder, but this is actually the truth, that a lot of the things that the programme proposes, is standard operational things that we already do in this province. Not to say that it's not valuable, but when we start moving out, in terms of mileage, let's say fifty miles out of this, while other provinces might get hundred miles out of this. There's a lot of things that are proposed that turn around the extension service and make it more efficient and whatever. There is a view, I think, spot-on things that we could seriously look at and say, you're not that good, you're not that grand, you should actually revisit this thing. And the report does make very strong recommendations and we seriously consider them. But others are, as I have said, standard practice. (Ben Saaiman, interview, 13 November 2003)

Implementation timeline

All extension staff in the WCDA, from the departmental manager to the regional managers and extension staff in each of the regions, were committed to implementing the recommendations. Implementation was scheduled according to a timeline with fixed dates. (See Appendix 2 for the Western Cape timeline for implementation for each of the five programmes.)

The issue of implementation were discussed at regional meetings and regions were questioned on the implementation process and progress.

I have quarterly meetings with my regional managers and this is a strict point on the agenda. We have set a deadline in the Swartland, how far are you with this? In the South Cape, how are you with this one? So, we've scheduled it over a period of two years, to implement everything that is proposed in this. (Ben Saaiman, interview, 13 November 2003)

5.3 Indicators of project success

Participatory dynamic: Project leader versus clients

According to Mr Ben Saaiman, representatives from the Western Cape extension services positively experienced Prof Düvel's guidance. Participation was invited at all levels from the first national workshop to the final report. Participants therefore took ownership of the project.

I cannot see how we could have done it differently. How Prof would have done it differently. Especially after the third mid-rand workshop. National, who employs him, could have said, look, we've decided on a national policy and this is how it will be. Prof, there's your brief, you go and you do it, forget about this collaboration and buy in and [] they will give us a representative from the provinces and they will make their inputs into this and we will write this thing. I think Prof is wiser than that. And, personally, I think that is the only way they could have done it and, in a sense, that is the only way that you can do extension, that's why Prof realises that, for in a way, this was also an extension project. Persuading people, leading people,

what the word “towards” means. “Towards” means that we are going somewhere. We are actually doing extension with this. And you cannot do extension from one side of the table. You have to reach out and you have to draw in the other side of the table. [] I don't think you could have done it in another way but it would not get buy-in and ownership and eventually implementation. (Ben Saaiman, interview, 13 November 2003)

According to Mr Saaiman he responded promptly when feedback or input was required from the project leaders. The energy and initiative for the continuation of the project came from him.

To answer that very shortly, I interacted when I was requested. When there was a meeting up there or when Prof visited us in the provinces. Or when we were asked for inputs via email. I promptly interacted when it was asked for. There were really no initiatives from my side proposing things or whatever. Prof was leading the process and as he asked for inputs, we gave it to him. Regularly. It was over a period of about three years we were heavily involved with this. It took quite a number of visits and a lot of time from me. (Ben Saaiman, interview, 13 November 2003)

The collaborative process of the project improved the sharing of ideas between provinces.

I always find it useful to share with other provinces. Not all of them are similar to the Western Cape, but I think you learn a lot by sharing with other provinces who have different viewpoints and they do things differently. And to listen to them, it is one of the tricks of extension; we should listen more than you talk. So, listening to the other provinces and trying to chew on what they are saying, this sounds wonderful; can I make it work in the Western Cape as well? So, I found that very valuable. (Ben Saaiman, interview, 13 November 2003)

The Western Cape extension manager, Mr Saaiman, was very explicit regarding the high value of the research process and the research outcomes. Agreement on principles were mostly reached without conflict or strong opposition.

But I can't recall a specific one where we were really head banging and saying, I won't give up on this and this is how I feel. We were, I think it actually went fairly smoothly. Certain different views on things, yes. But I can't recall such a strong conflict of opinions. (Ben Saaiman, interview, 13 November 2003)

“Revolutionary” changes in extension approach

Some recommendations were viewed as revolutionary by Mr Saaiman, particularly the new structure of service provision.

I think one specific one is what Prof calls the subject matter specialists, as a technical backup to frontline extension officers. That is once again not with us, but with many provinces, the majority of them, it is revolutionary. They didn't have this and there's a lot of pages dedicated to that topic and the explanation of the role of such a person. Subject matter specialists are, as the name says, specialists in specific subjects. Like a guy would

be a specialist, let's say in wheat production, have a degree or even Masters degree in that and he really is a specialist in that. And act as a support system for extension officers. Now that person would probably be involved in research, could also be involved in formal training as a lecturer at a college and merely be seen in the industry as a specialist in wheat production. [] That is what the report proposes, that every province should have a small core of specialists who can act. And we actually proposed this. There is a job description for that as well. [] the function of this person is the training of extensionists, in other words, that's function number one. He is a specialist in his field, but training his colleagues is a first task. The second one is to continuously and purposefully do knowledge upgrading of extension officers. So it is sort of inward towards his colleagues, assistance and advice to farmers. [] He needs to really be a specialist to advise commercial export farmers. So this person is still an extension officer, advising the high-level commercial farmers, but using that knowledge and deliberately pushing it down to his colleagues who are the generalists. Then there's the assistant extension officers with problem cases as I've mentioned. Assistant extension officers with message design and project design focus. [] Once again, it is standard practice in the Western Cape. I even have extension officers with PhDs who really are specialists. (Ben Saaiman, interview, 13 November 2003)

Implementation structure

Some recommendations were in place in the Western Cape before the project started while others, such as programme D (education and training), would receive attention:

I think in terms of programme D, that is really where we can invest in our own staff. And I did recommend to the team, we are actually in the process of doubling our staff, a motivation that we actually won. We've been motivating for two, three years in terms of land reform, saying, if land reform is adding new clients, we're not losing clients, we still have our eight thousand commercial farmers and more or less four thousand small-scale farmers. With land reform, every month we're adding land reform beneficiaries who are new farmers. What I'm trying to say, the people that you will appoint as new officials, in my opinion, they will need a lot of in-service training. So, to answer your question, we don't have a structured programme for in-service training. That is something that is lacking. So, programme D is one that we seriously needs to look at. (Ben Saaiman, interview, 13 November 2003)

Mr Saaiman expressed the need that the programme managers' workgroup should not terminate. He felt that it should continue operating as a collaborative body, with Prof Düvel, to act as sounding board during the implementation phase. It would provide a context for provinces to air their views and problems. The workgroup could also benchmark and compare provincial implementation practices.

Some of the recommendations say, develop guidelines and criteria for monitoring and evaluation. Establish a basis for comparative monitoring and evaluation comparing between provinces. Now, you will see on number

one, three, four and five, we said this issue should be dealt with a national workgroup. We accepted this as a recommendation, but really, this is our view that it would be redesigning the wheel times nine, if we say, look, we will develop a monitoring and evaluation system for the Western Cape, how will we monitor the execution of our extension programme? Whether they are actually reaching their targets, the costs of it, etc. And now Northern Cape and Eastern Cape and everyone start designing their own monitoring and evaluation and comparing budgets and, this is actually a national issue. A lot of provinces actually thought, look, this thing is now done, we were a workgroup for two years, we've gathered inputs, this is our report, we will implement it, but do we actually now dissolve or should we still have this structure where the provincial departments, maybe just once a year or once every six months, get together, saying, look, we have made this thing, we have committed ourselves to implement it, this coming back after six months saying, how far have we got? There is my plan, I'm not shy, there's my plan, what have I done. And I've tried this, but really, I said I will do this, but now that I'm into implementation, it doesn't work, so I'd like to speak to KwaZulu Natal and get their viewpoint. In our province it doesn't work, this is what we're actually asking, maybe there should be a body, as we were, national plus the nine provinces, who just regularly revisit this thing. (Ben Saaiman, interview, 13 November 2003)

Developmental extension versus commercial extension

The relevance of extension services to the commercial farming sector is linked to the particular industry and the kind of specialised extension support that is needed. The geographical location of some of the Agricultural Research Council's (ARC) institutes also contributed to this aspect.

In some cases we've become irrelevant. Totally irrelevant. In other cases, we are very much in demand. And it's industry-based sort of. Take the wine industry. We are totally irrelevant. It is a sophisticated industry, it is high-level. The fruit industry is another one. We have the agricultural research council at Infruitec at Nietvoorbij in Stellenbosch. Traditionally they've been servicing those farmers and now that's where the decline is, unfortunately. But, if you should take the wheat industry for instance, the ARC, if they are our competition. They are in Bethlehem in the Free State. They are totally irrelevant for the wheat farmers of the Western Cape. So there we are very much in demand and we do a lot of research and a lot of extension projects to commercial wheat farmers. So, the answer is in most ways industry-specific. (Ben Saaiman, interview, 13 November 2003)

Accessing tacit knowledge?

According to Mr Saaiman the vast experience Prof Düvel in the extension field benefited the research process and the involved parties:

I think that is probably why some of our sessions lasted many many hours. Because Prof Düvel has such a vast experience and depth of knowledge. I mean, to his credit, I think he is very much on the ball with modern things, he is not like many academics who repeat theory of twenty years ago. Prof is

still on the ball with new, you know, particularly human things like behavioural change, and especially in Europe, there's a new line of thinking, and he brought to us and said, look, I've heard about this, I do not necessarily agree with it, I throw it on the table, and what do you say. And we had to choose on this thing, whatever. So, yes, Prof brought a lot of fresh ideas and old things that even is in his make-up sort of that we were exposed to. (Ben Saaiman, interview, 13 November 2003)

Effective utilisation?

The Western Cape extension service perceived the utilisation as successful. Some aspects (such as education and training) were not yet implemented, but most recommendations were either already implemented or in the process of being implemented.

Official project continuation

The national workshop for the official launch, after approval of the final report by the NDA, has not been held.

[In a letter written and] signed by Prof Düvel on behalf of the Director General [] Prof said in the letter, this is what I read between the lines here about national, it says discussions will soon be held, this is the fax that actually says the workshop is postponed until January 2004, it said in the last paragraph, discussions will soon be held with national Department with Agriculture, then in brackets, where changes have apparently been made regarding a directorate or even a chief directorate that will be specifically responsible for extension. And I think, this is exactly what I said, that there should be some capacity up there with which we can interact. (Ben Saaiman, interview, 13 November 2003)

The national workshop would be a public event where provinces would receive the official notice to implement.

The workshop will primarily be a launching occasion where the report as a final project now will be launched and saying, if this is done, now we have to implement, implementation would be launched. And then, specifically, the provinces will have to report on how they will be implementing the programme. This comes from national, not from Prof Düvel. So, I think we have freedom, yes, but national is going to sort of, demand, that look, we've spent two years and a lot of money and effort into this, we simply cannot chuck it off the table, and say I disagree with everything and I will not implement anything. There will be pressure with the implementation, but maybe we will have some freedom saying but, really, this thing, it is not like it is irrelevant, but for our province, we are not going to implement this. We don't feel we need it and we will motivate why we will not implement this. I hope that we will have that kind of freedom. But, there will be pressure, surely, to implement most of this, otherwise the whole effort was useless. (Ben Saaiman, interview, 13 November 2003)

6 Concluding observations and lessons learnt from this case

6.1 Research methodology

The relationship between the national Department of Agriculture and the provincial Departments of Agriculture was perceived by interviewees as possibly having a negative effect on the research process. The provinces, as stipulated by the Constitution, managed their own departments; and the relationship with the NDA is not always clear concerning issues such as policy and operational directives. Representatives invited to the first national workshop were unanimous that a national framework on extension was important but only if a non-prescriptive approach was followed. The self-sufficiency of the provincial departments on the one hand, and the necessity for involvement by the national department on the other, contributed largely to the participatory action research approach chosen by Prof Düvel.

Drafting a new extension framework from a participatory action research methodology reflected an intricate research scenario. Stakeholders from various constituencies participated at various workshops during the research phase. Amongst these were the research team guided by Prof Gustav Düvel, the representatives of the national Department of Agriculture, and the representatives from extension departments in the provincial Departments of Agriculture. Some agriculture-related non-governmental organisations were also involved in the early phases of the research.

The research activities consisted of workshops where inputs regarding extension principles were made and where, under the leadership of Prof Düvel, capacity building were facilitated.

The research framework had epistemological and methodological implications because a direct link existed between the modes and contexts of knowledge production and utilisation. This is different from other research designs. For instance, the design depended on the participation of potential users in order to ensure the relevance of the approach, and the chances for successful uptake and implementation. The design furthermore provided for a dialectic interaction between research-related activities, such as questionnaire-based surveys and workshops, and capacity building of all participants.

The interactive inputs from all extension staff were captured in the final report and recommendations. The content of the 2002 draft national extension framework was therefore perceived to be their “own” by extension personnel. The intra-provincial perspectives and practices on extension were assimilated into the extension framework.

Considerably less emphasis therefore was placed on the more conventional academic or Mode I objectives, approaches and outputs. Some resistance was expressed by representatives at the workshops against an all too “academic” approach.

6.2 Utilisation progress

Prof Düvel recommended one user because not all the provinces, as the prime users, were ready to implement when this case study report was drafted. The extension

department at the Western Cape Department of Agriculture was singled out as the locality where utilisation had progressed furthest.

The participatory condition contributed largely to the commitment of the province to implement the recommendations. Many extension practices that were part of the provincial extension approach were incorporated into the final framework document. They could therefore identify with it and expand it to include the added recommendations identified by the participatory process.

6.3 Future utilisation success?

Remarks from Prof Düvel, the national programme manager, and Mr Saaiman, the manager of the extension service in the WCDA, indicated that unresolved structural issues might have negative effects on the medium- and long-term implementation of the programme in the future. The legitimacy and structural viability of this national project was not always self-evident. The acceptance and implementation commitment of the recommendations at provincial level, as well as the management of the implementation and evaluation processes at the macro level, have not yet been indicated. Continuing management changes in the top structure of the national Department were perceived as being instrumental to this and have inhibited the continuation of the research process⁷. Prof Düvel described this as follows:

I think we have more problems than we had previously. To be more specific, for example, I have a contract research project lined up. It was for example with the Department of Environment. Now this was given the green light almost 18 months ago and subsequently the contracts were drawn up to the satisfaction of those in the University as well as the Department. Since then, I can't get the signature. [] apparently there's a conflict between the [Member of the Executive Council] and the Head of the Department, and he doesn't want to sign. Other things have to do with, for example, in interacting with the Department of Agriculture; it is very difficult to get the sponsors. It is as if what was always bad in civil services mainly to take a decision has got much worse. (Gustav Düvel, interview, 17 August 2000)

The tender was issued by the NDA and suited the Integrated Sustainable Rural Development Programme adopted by government. This should provide the basis for the full implementation and management of the new framework for agricultural extension in South Africa in future.

The greatest opportunity lies in I think the circumstances in which we are finding ourselves in currently, and that is that the tremendous needs and also probably the pressure that face the government to really bring about a turning point as far as rural development is concerned. So that's really the big need and emphasis... (Gustav Düvel, interview, 10 November 2003)

⁷ Amongst the unresolved issues that were highlighted to inhibit the process, were the launch of the new extension framework at a national workshop and also the policy writing process that should commence thereafter (Gustav Düvel, interview, 10 November 2003)

Capacity, commitment and accountability pose a potential treat to the successful implementation of a quality extension service. The sheer magnitude of the developmental need and the lack of well-trained and committed extension staff, could have a negative effect, and would require diligent project management.

On the other hand what is the threatening thing is the lack of commitment, perhaps also circumstances that prevent that something happens in the field in terms of development, and perhaps the lack of accountability, which obviously could lead to further budgetary cutbacks. In other words one might reach the situation where although you can have all the arguments and evidence that there is a tremendous need and that it is worthwhile investing in the research and training and all these actions, but that the situation might come where they say okay, we agree it is necessary, we agree it is even profitable in terms of investment in those fields, but it is no longer affordable. (Gustav Düvel, interview, 10 November 2003)

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Mr Ben Saaiman (Head: Sub-directorate technology transfer, WCDA), 13 November 2003

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Appendix 1: Summary of findings and recommendations⁸

Introduction

The large majority of recommendations apply equally to all provinces, and are of a rather general nature (mainly because specific provincial statistics are unavailable or were inaccessible).

The recommendations are summarised under the ten principles and are largely based on the feedback from the provinces, which, in many cases showed remarkable similarities in viewpoints or opinions, but sometimes also significant differences. The main purpose of these recommendations is to form a basis for further interaction with provincial management teams so that they can ultimately identify and formulate their own approach or system, capture it in a policy document and also agree and commit themselves to those specific principles that should apply and be implemented as national policy.

Recommendations regarding extension principles

Ten principles (below) were drafted as a result of the participatory process. These formed the framework from which five programmes were drafted with the aim of implementation.

- 1 Mission, Goals and Priorities
 - 1.1 ... the understanding of extension and the resulting approach, makes it inevitable that clear policy guidelines are set in this regard.
 - 1.2 ... the emphasis should clearly be on the capacity building side, but allowing for a mix that meets situation specific needs and circumstances.
 - 1.3 A priority approach is essential in extension in South Africa given, on the one hand, the overwhelming task and challenge in agricultural and rural development and, on the one hand and, the limited resources.
- 2 Needs Based Development
- 3 Community Participation and Involvement
- 4 Institutional Linkages and Structures for Participatory Extension
- 5 Purposeful or Programmed Extension
- 6 Knowledge Support Services
- 7 Education and Training
- 8 Pluralistic and Co-ordinated Extension
- 9 Privatisation and Outsourcing
- 10 Monitoring, Evaluation and Accountability

Proposals regarding the implementation of a Participatory Programmed Extension Approach (PPEA)

The ten principles as stated above, are incorporated into 5 programmes meant to be implemented and incorporated into extension practice in the provinces.

⁸ The whole of this section refers to the Executive Report, 2003 (Recommendations from Final Report, *Towards an appropriate extension approach for South Africa*, December 2002).

PROGRAM	PROGRAM DESCRIPTION	RELEVANT PRINCIPLES (Paragraph number)
Program A	Extension Planning and Projects Program	<ul style="list-style-type: none"> - Mission, goals and priorities (2.1) - Needs based development (2.2) - Community participation and involvement (2.3) - Purposeful or programmed extension (2.5) - Privatisation and outsourcing (2.9)
Program B	Extension Linkage and Coordination Program	<ul style="list-style-type: none"> - Institutional linkages and structures for participatory extension (2.4) - Pluralistic and coordinated extension (2.8)
Program C	Knowledge Support Program	<ul style="list-style-type: none"> - Knowledge support services (2.6)
Program D	Education and Training Program	<ul style="list-style-type: none"> - Education and training (2.7)
Program E	Monitoring and Evaluation Program	<ul style="list-style-type: none"> - Monitoring, evaluation and accountability (2.10)

The first step towards implementation is proposed to consist of workshops with the extension managers in the provinces for purposes of feedback and for the provinces to respond to the proposals by selecting the proposals acceptable to them and by integrating them into a revised extension policy, which is congruent with the broad principles, but adapted to provincial specific situations.

Following the round of workshops in all the provinces and based on the outcomes regarding the Provinces' choice of principles or alternatives within the principles, it will be possible to formulate a national policy based on provincial consensus and agreement regarding the important extension approach related issues.

Programme managers are to be appointed for each programme in every province. They are to take responsibility for the program design and implementation within the provinces and are accountable to their provincial management, but for purposes of exchanging views and experience and ensuring optimal solutions and progress in all provinces, there should be coordination between the provinces under the leadership of a National Programme Manager.

Within the provinces the implementation is to occur with the collaboration of district representatives who in turn are responsible for the program implementation at district level. The provincial program managers are expected to lead and coordinate the program in the provinces. It stands to reason that provincial program managers, although expected to liaise with the National Program Manager and through him with the program managers of other provinces, are primarily responsible and accountable to their provincial extension management.

Appendix 2: Western Cape utilisation/implementation timeline

Implementation plans for the Western Cape

(Adoption and implementation of recommendations by extension management group)

Program A: Planning and projects	
PURPOSE	Western Cape implementation
The reconsideration of mission, objectives and priorities and the improvement of the effectiveness and efficiency of all projects and programs	
Objectives and activities:	Target date
1. Reconsider and redefine mission and goals	March 2003
2. Develop guidelines regarding pro-active (programs) and re-active/ad-hoc activities	April 2003
3. Develop a data bank of all projects/programs categorized according to typology	Continuous
4. Set standards for projects/programs	Continuous
5. Develop guidelines and implement measures to prevent program interruption or “derailment”	April 2003
6. Develop or outsource the development of a manual for programmed extension	April 2003
Program B: Institutional linkage and co-ordination	
PURPOSE	Western Cape implementation
The establishment of institutions and/or institutional linkages for effective participatory and coordinated development	
Objectives and activities:	Target date
Update or develop database on number of clients in district and local municipalities, wards and villages.	October 2003
Update existing clients database	April 2004
Update inventory of small-scale farmers	April 2004
Acquire a landowners database	March 2005
Re-write existing Regional Information Inventories to fit District Municipality	
2. Re-delineate and re-group service areas or wards (clustering of villages, farmers' associations, wards, etc. into units that are manageable and as homogenous as possible).	February 2004
3. Increase identity of wards and communities' association and identification with them.	Continuous
4. Create guidelines for and implementation of linkage structures	Continuous
5. Categorise extension staff into extensionists and technicians with the former taking responsibility for programs (projects) and delegating operational activities to technicians under their supervision	September 2003
Program C: Knowledge support	
PURPOSE	Western Cape implementation
Development of an effective knowledge support system (consisting mainly of SMS)	
Objectives and activities:	Target date
1. Appreciate the urgent challenge for a strong knowledge support system	Continuous
2. Assess the type and the numbers of SMSs required and identify and recruit suitable personnel for that purpose.	September 2003
Current Agric. Scientist vacancies	April 2004

Appointment of an Extension Specialist Use of Research specialists	Continuous
3. Establish collaboration networks	August 2003
4. Develop job descriptions for subject matter specialists which emphasize their pro-active supportive function	September 2003
5. Establishment of an Extension Knowledge Information and Research Centre motivate for an additional post for the appointment of an Extension Specialist. Continuous in-service training of Extension Officers (30 %)	April 2003 September 2003
6. Develop or outsource the development of a framework for performing skills audits among extension workers Motivate for an additional post for the appointment of an Extension Specialist. Appoint Extension Specialist	April 2003 April 2004
7. Specifying the minimum degree to which a province should also focus its extension on commercial farmers.	April 2003
Program D: Education and training	
PURPOSE	Western Cape implementation
Improvement of the credibility and competence of extension personnel in the technical, economical and extension fields	
Objectives and activities:	Target date
Set guidelines for a recruitment and appointment policy	April 2003
Redesign Extension service structure to focus on needs of clients	
Redesign job descriptions of all Extension staff	September 2003
2. Select and recognize programs of tertiary institutions on the basis of quality and content	Continuous
3. Negotiate with tertiary institutions regarding more appropriate formal education programs and qualifications	Continuous
4. Challenge tertiary institutions to come up with effective bridging possibilities from diploma to degree programs.	Continuous
5. Improve the quality of college training through the involvement of SMS	Continuous
6. Change college course presentation into short and block type modules	Continuous
7. Develop structures and programs for the improvement of skills training of extension workers Appoint Extension Specialist. In-service training of Extension Officers	April 2004 Continuous
8. Implement the SASAE proposal regarding the career path of extensionists Extension management group to study, evaluate and discuss the SASAE proposal Possible implementation of the SASAE proposal	April 2004 June 2004

Program E: Monitoring and evaluation	
PURPOSE	Western Cape implementation
Development and implementation of an effective monitoring and evaluation program for improved accountability and continuous improvement of current and future extension	
Objectives and activities:	Target date
1. Develop guidelines in respect of the choice of M & E criteria.	June 2003
2. Develop a core of essential and useful report forms that apply nationally, which can, where necessary, be supplemented with provincial-specific ones	Continuous
3. Establish a basis that allows for a comparative monitoring of extension inputs on a budget basis.	June 2003
4. Prepare guidelines and outsource the development and presentation of M&E training program to be offered countrywide.	June 2003
5. Revisit and adapt the current merit assessment scheme	June 2003

CASE STUDY 8

THE DOMESTICATION OF INDIGENOUS VEGETABLES

Improving rural diets by re-establishing vegetables from the past

A research project, led by Ms Phatheka Peter of the Agricultural and Rural Development Research Institute, University of Fort Hare

by Gerrit Loots



A member of the Gqumahashe Agricultural Development Project, proudly showing off his produce. Photograph courtesy of: **ARDRINEWS**, July and December 2002

CONTENTS

Abbreviations	368
1 Introduction	369
2 Organisational context: The Agricultural and Rural Development Research Institute (ARDRI)	370
2.1 Operational brief and philosophy of ARDRI	371
2.2 Staff and budget	372
2.3 Portfolio of research, teaching, training and community projects	372
2.4 Contacts and collaboration	375
3 The mode and context of knowledge production	376
3.1 Project context and history	376
3.2 Project aims	377
3.3 Project team and funding	378
3.4 Project description	378
3.5 Project outputs and deliverables	385
3.6 Reaching the research aim: A project manager's perspective	386
4 The mode and contexts of knowledge utilisation	386
4.1 The utilisation sites: Lower Gqumahashe, Guquka and Roxeni	387
4.2 Farmers' preferences and perceptions	388
4.3 Training and support from the project manager	389
4.4 Different practices	390
4.5 Selling the produce	391
5 Concluding comments	391
5.1 Key observations and lessons learnt	392
Data sources	394
Face-to-face interviews	394
Telephonic interview	394
Email responses to additional questions	394
Publications and documents	394

Appendix 1:	Demographic data for Nkonkobe Municipality, Eastern Cape.....	395
Appendix 2:	Questionnaire: assessment of diversity, production systems and selection of cucurbits for improvement	396
Appendix 3:	Interview framework used during interviews with small-scale farmers at Guquka, Lower Gqumahashe and Roxeni	398

Abbreviations

ARDRI	Agricultural and Rural Development Research Institute
CCETSA	Canon Collins Educational Trust for Southern Africa
CDS	Centre for Development Studies
ECDA	Eastern Cape Department of Agriculture
EU	European Union
GTZ	German Technical Co-operation
HSRC	Human Sciences Research Council
ICUC	International Centre for Underutilized Crops (UK)
IDT	International Development Trust
KLV	Dutch Royal Agricultural Society
NRF	National Research Foundation
PFID-FV	The Partnerships for Food Industry Development – Fruit and Vegetables
RFC	Roxeni Farmer's Co-op
SANPAD	South African Netherlands Research Programme for Alternative Development
UFH	University of Fort Hare

1 Introduction

Rural households throughout South Africa are confronted with the two critical and related issues, namely the availability of food and the poor nutritional status of families. Various studies, such as the one by Monde (2000:6), have indicated that poverty is regarded as a central cause of hunger and malnutrition amongst rural inhabitants. Natural disasters, but also certain policies such as motivating crop speciality for economic reasons, are viewed to be some of the main reasons for food insecurity.

The availability and quality of food has a significant impact on improved living conditions and health of communities in these areas and is therefore a central feature of the strategic thinking of the South African national Department of Agriculture. Improving the capacity of rural families to sustain themselves through small-scale farming and/or backyard gardens is perceived to play a very important role in reaching the strategic goal of improving food security.

International development (research) organisations, such as the International Centre for Underutilized Crops (ICUC), often have the same goal, namely to alleviate food-related problems amongst rural communities by research into indigenous and often underutilized crops. This is elaborated in the ICUC's mission statement as follows:

Food security, improved nutrition and economic welfare of human beings raised through sustainable and increased production of food and industrial raw materials. This is to be achieved by using the untapped biological diversity of underutilized crops. (<http://www.civil.soton.ac.uk/licuc/8.html>)

The project described in this case study, namely *The domestication of indigenous vegetables*, was the result of a grant from the ICUC to the Agricultural and Rural Development Research Institute (ARDRI) at the University of Fort Hare. Both organisations share the goal of contributing to food security within rural communities. Agriculture (small-scale farming) is identified as a vital source of livelihood and is practiced by 1 594 people in the Nkonkobe municipality in the Eastern Cape province where the project was established¹. It therefore made good sense when ARDRI decided to apply the ICUC funding to work towards the re-establishment of traditional and indigenous vegetables, namely Amaranthus, Cucurbits and Plectharanthus, in the villages of Guquka, Lower Gqumahashe and Roxeni.

Before turning to a more detailed discussion of the project itself, the organisational context within which the project is located, namely the ARDRI in the Faculty of Agriculture and Engineering Science at the University of Fort Hare is presented.

¹ See Appendix I for demographic information about the Nkonkobe municipality.

2 Organisational context: The Agricultural and Rural Development Research Institute (ARDRI)²

The Agricultural and Rural Development Research Institute (ARDRI) is located within the Faculty of Agricultural and Environmental Sciences at the University of Fort Hare in the Eastern Cape town of Alice. At the time of its establishment in 1916, the University of Fort Hare was known as the South African Native College. Fort Hare provided academic training to black students at a time when access to traditionally white tertiary institutions was often difficult and even prohibited. It produced graduates from South Africa and as far north as Kenya and Uganda. Many went on to prominent careers in fields as diverse as politics, medicine, literature and art. Some politically-active alumni like Oliver Tambo, Nelson Mandela, Govan Mbeki, Robert Sobukwe and Mangosuthu Buthelezi in South Africa, Robert Mugabe and Herbert Chitepo in Zimbabwe, and Eliud Mathu and Charles Njonjo in Kenya, are well known alumni of this institution.

The Faculty of Agricultural and Environmental Sciences is one of four faculties at the University of Fort Hare. The faculty consists of four departments, namely Agricultural Economics, Extension and Rural Development; Agronomy; Livestock and Pasture Science; and, Geography and Environmental Science.

In addition to the four departments, the Agricultural and Rural Development Research Institute (ARDRI) forms an integral part of the faculty and acts as an “outreach arm” (Annual Report, 2001-2002, 3) between the Faculty and the communities it serves. The Faculty conducts its work mainly in participation with the end-users, namely communities in rural and farm settings. Its goal is defined as “... to contribute to the revitalisation of agriculture in the region by means of culturally adapted and community-driven processes of development” (ibid).

The students registered at the Faculty are from South Africa and many foreign countries, particularly from Africa.

The Agricultural and Rural Development Research Institute (ARDRI) was established in 1977 through the vision of the Faculty of Agriculture at the University of Fort Hare. The explicit goal for the establishment of the Institute was to research the agricultural and economic needs of rural communities. Prior to 1994, ARDRI used to operate in all corners of South Africa, especially in the former homelands and self-governing states. Presently, ARDRI is concentrating its efforts mainly in the Eastern Cape province.

The financial crises experienced by the University in 1998 were also felt by ARDRI when the Institute was requested to reduce the University’s contribution to its budget. This had the result that both the acting director (Dr Wim van Averbeké) and the secretary accepted retrenchment. From the end of the year 1998, the university would not contribute to ARDRI’s budget in future.

² The background information on the University of Fort Hare was gleaned from the institutions web site at <http://www.ufh.ac.za/>. The institutional profile of ARDRI is based on the latest annual report at the time of the interviews, namely the one dated September 2002 and covering the period 2001-2002. The section on the history of ARDRI draws mainly on the outline as published in ARDRINEWS, July and December 2002, under the heading, ARDRI the Organisation.

2.1 Operational brief and philosophy of ARDRI

From the broad goal of pursuing research topics related to agricultural and economic needs of rural communities, a more defined brief has developed over the years to include the following:

- ◀ To improve the quality of life of rural people by enabling them to make maximum use of the resources available to them
- ◀ To conduct research that will promote rural development
- ◀ To provide specialist advice in the fields of agriculture and rural development
- ◀ To interface between the expertise and knowledge available at the University on the one hand and the expressed development needs of the people on the other
- ◀ To actively seek funding for rural communities to implement development projects and play an important supportive role in those projects
- ◀ Training and capacity building through organising specialised training courses for people involved in agriculture and rural development, and
- ◀ To involve postgraduate students in the institute's projects thus providing trained personnel with experience in rural development³.

The projects at ARDRI are based on five core values. These include:

- ◀ An appreciation of the vital roles played by leadership training and institution building in communities
- ◀ Recognition that communities must assume responsibility for their own development and should be empowered towards this end
- ◀ The need for better water reticulation and the potential of home gardens for food production
- ◀ A realisation of the overriding importance of livestock production and the need to safeguard this industry by utilising communal grazing in a more efficient and ecologically stable manner, and
- ◀ The need to integrate livestock production with arable land use.

Multi-disciplinary teams working closely with rural households to identify possible problems and constraints and to adapt and test alternative solutions to these, form a vital operational methodology of the ARDRI business. When specialised input is required, this is sourced from different departments, within or from without the Faculty of Agricultural and Environmental Sciences.

Different aspects of ARDRI's operation include:

- ◀ Assistance in the formulation/conceptualisation and writing of proposals
- ◀ Project facilitation and management aid
- ◀ Field surveys and related research activities
- ◀ Project Monitoring and Evaluation, and
- ◀ Training on various agricultural related topics (ARDRINEWS 2002).

³ ARDRINEWS, July and December 2002.

2.2 Staff and budget

The Institute's operational budget comes mainly from grants and contractual income. The major part of its budget comes from an annual grant from the Eastern Cape Department of Agriculture (ECDA). This does not, however, cover all the staff costs with the result that some of the specialist researchers are currently contracted from other departments according to research and contract needs.

Since the previous report year, 2001, the staff situation has changed mainly because of budgetary constraints. At the time of the interview with the Director (July 2003), the previous full-time positions of the agronomist, the soil scientist and the social scientist were replaced by a needs-based agreement with the Faculty of Agriculture and Environmental Sciences and the Department of Sociology from where the required know-how would be sourced if the need arises. The vacant post of Deputy Director is also not filled due to financial limitations. Of the post structure of ten positions (including a secretary) only five are filled currently. Funding from the Eastern Cape Department of Agriculture and the International Centre for Underutilized Crops is used to fund these posts. In addition, some external funds are also used to contribute towards the funding of staff posts.

ARDRI also uses various temporary project staff members. During the 2001-2002 report year, one seconded postgraduate staff member and five undergraduates assisted with projects, while two extension officers from the ECDA were also involved in projects. ARDRI also has an internship-volunteer programme that enables postgraduate students to gain experience through their involvement with ARDRI projects.

Apart from the important annual contribution of the ECDA to ARDRI's budget, the following institutions also supported ARDRI: Canon Collins Educational Trust of Southern Africa; the National Research Foundation (NRF); the South Africa-Netherlands Partnership for Alternative Development (SANPAD); and, the ICUC. Funds generated from services rendered to organisations were received from Amatola District Municipality, Border Rural Committee and the German Technical Co-operation (GTZ).

2.3 Portfolio of research, teaching, training and community projects

Planning for the Institute is done annually at a strategic planning meeting between various parties. This is done according to ARDRI's vision and mission and fits into the research and activity portfolio.

We have a strategic planning meeting at the beginning of the year. We lay down the areas on which we have to concentrate. Also we get other stakeholders and funders who have their agenda and we have to feed our activities. After planning we come up with proposals and then we discard some of them. The people who compile the proposals are the team leaders of that particular project. (Patrick Masika, interview, 22 July 2003)

These stakeholders include various groups from academic departments, the Faculty of Agriculture and Environmental Sciences, and non-governmental organisations involved with development. As Patrick Masika noted: "We sometimes work with NGOs to give us

a sense of what is needed in terms of development and to see if we are still relevant in what were doing” (Patrick Masika, interview, 22 July 2003).

A shift in focus over the years, based on consultancy requests, had the result that ARDRI narrowed its research towards Eastern Cape rural agricultural needs.

Before 1992/ 1994 ARDRI was working in different areas of South Africa, Venda, Botswana etc. ARDRI was concentrating on agricultural related topics, but in the last five years we have been concentrating more on the Eastern Cape, because we have been getting consultancy questions from National Government. So you find that where our emphasis was previously on broad agriculture, we now focus on aspects of rural development, not only concentrating on research but also implementing rural activities and projects. We also bring in the social aspects, which we never previously had. We also involve agricultural economists, we found that was needed on our team, the trend is that we will also have to involve GIS activities into our output activities. (Patrick Masika, interview, 22 July 2003)

Short-, medium- and long-term strategic plans of the national Department of Agriculture are taken into account by ARDRI when its research focus is determined.

Some of our activities are informed best by the Department of Agriculture. [] they have a five-year plan. We look at certain aspects of their vision, for example, of late in the Eastern Cape, the Department is looking at mass food production. So there we get involved in such activities whereby some of the extension officers call on us to provide training and assistance for them to really focus on mass food production. (Patrick Masika, interview, 22 July 2003)

Specific local communities, namely Koloni, Guquka, Lower Gqumahashe and Roxeni in the Eastern Cape province, were chosen by ARDRI as the main areas where the selected research projects would be implemented and managed with the collaboration of the communities. The selection of these communities was based on consultation and inputs from ECDA extension officers.

Current research projects

The following are the research projects currently underway at ARDRI:

- ◀ Water/irrigation-related projects mainly focused at Koloni where two projects are currently in operation.
- ◀ The project dealing with the domestication of indigenous vegetables (the focus of this case study) engaged the villages of Guquka, Lower Gqumahashe and Roxeni.
- ◀ Promoting agriculture through school vegetable gardens. During 2000 a preliminary study was undertaken by ARDRI in collaboration with extension officers from the Department of Agriculture and Land Affairs (DALA). This was followed by a pilot project starting in 2001. The aim of the project was to institute demonstration gardens at selected schools.
- ◀ Market development for the small or rural farmer: exploring the gaps in the fruit and vegetable market for profits (Annual report 2001-2002, 23). This is a joint

venture between ARDRI and the Roxeni Farmer's Co-op. A decision was made to plant the vegetables Okra and Habaneras Chillies. The harvested products were sold through individual agents at farm gate prices who, in turn, distributed it to outlets such as restaurants, vegetable shops/spazas and the market in East London.

Improving markets for the small emerging farmer. The Partnerships for Food Industry Development – Fruit and Vegetables (PFID-FV), is a collaborative project between ARDRI, the United States Agency for International Development, Michigan State University, and the Centre for Development Studies at the University of Fort Hare. The overall objective of the project is to bridge the gap from both ends of the production chain by gathering information about the products of the small-scale farmers and information on available market opportunities (Annual report, 2001-2002, 27). This resulted in an agreement with the food chain, Pick n Pay:

The Pick & Pay stores have started buying farm products from small farmers in the Nkonkobe region. The first consignment of 2000 kg of butternuts was delivered to the Super market's food distribution centre in Port Elizabeth on Wednesday 19/03/03. Prior to the purchase Pick 'n Pay's technical team (a buyer and food technologist) visited the production sites to make sure that the farming environment and the products were in line with their prescribed specifications. Current production projections show that the farmers can conveniently meet the initial weekly supply of 2000 – 3000 kg till the end of the year 2003. (<http://www.ufh.ac.za/>)

The Gqumahashe Agricultural Development Project. ARDRI is involved in the implementation and monitoring of the two-phased development of vegetable production units.

The role of indigenous knowledge in agriculture. The main aim of this project is to document the use of medicinal plants and other indigenous practices in agriculture, more particularly to treat livestock ailments. (Annual Report 2001-2002, 31).

The project focusing on the improvement of markets for emerging farmers is currently the most prominent and promising one generating enough funds to put more work into it.

ARDRI's research outputs are directed at a variety of groups including end-users, policy makers in the agricultural sphere, students, fellow academics, educators and trainers. These outputs include research reports, conference papers, best-practice guides for end-users and journal publications. ARDRINEWS, the annual publication of the Institute, reaches about 800 subscribers in South Africa and abroad and serves as an important vehicle to convey the Institute's focus for the past year (Annual Report, 2001-2002, 3). Outputs for the report year 2001-2002 were 4 articles in journals and two academic papers presented at conferences.

Teaching, postgraduate supervision and outreach activities

The Director of ARDRI co-supervises postgraduate students from the Faculty of Agriculture and Environmental Science while staff members are also responsible for teaching some courses at the Faculty.

ARDRI presents short courses to rural communities on the basics of vegetable and broiler production. Farmers are also given on-site advice on issues such as irrigation. It also manages funds for communities when so requested, such as with the Gqumahashe Agricultural Development Project.

2.4 Contacts and collaboration

The following departments, research programmes, foundations, trusts and centres, local and international, are part of ARDRI's past and present collaborators:

- ◁ Canon Collins Educational Trust of Southern Africa (UK)
- ◁ Eskom-AGRELEK (SA)
- ◁ German Technical Co-operation (GTZ)
- ◁ Human Sciences Research Council (HSRC)
- ◁ International Centre for Underutilized Crops (ICUC, UK)
- ◁ Land and Agricultural Policy Centre (SA)
- ◁ One Family Foundation (USA)
- ◁ South African Netherlands Research Programme for Alternative Development (SANPAD)
- ◁ South African Water Research Commission
- ◁ UK Department for International Development (DFID), and
- ◁ National Research Foundation.

ARDRI is also involved with two non-governmental organisations; namely Heifei International which is based in KwaZulu-Natal and the Eastern Cape; and, Vukani Community Training – an American non-governmental organisation that operates in South Africa.

Since 1998, ARDRI has taken part in various collaborative research projects with international partners. The institute became involved in co-operation with the universities of Manchester and Bradford in the United Kingdom, and Makerere University in Uganda. The collaboration with the University of Wageningen led to accessing SANPAD funding and securing much-needed specialist volunteers in the area of geographic information systems and statistics.⁴ ARDRI and the Faculty of Agriculture also signed a co-operative agreement with the University of Gent and Antwerp in Flanders (Belgium) (**ARDRINEWS**, 1998 - July and December, 2).

The depth of experience in rural development projects, established networks of collaboration and co-operation, as well as a vision to make a difference amongst rural communities through agriculture-related projects in the Eastern Cape, made ARDRI the obvious choice for the re-establishment and domestication of indigenous vegetables amongst small farmers.

⁴ Ms Deanne van Nederveen and Lothar Smith, sponsored by the EU and the Dutch Royal Agricultural Society (KLV), strengthened ARDRI's staff position in 1999.

3 The mode and context of knowledge production

This project is best characterised as applied research and community-based development, that includes an agricultural extension dimension. Largely, the contexts of knowledge production and utilisation are closely interlinked. For analytical purposes, however, these two contexts are discussed separately. The project activities are presented from the point of view of the research team at ARDRI, with a specific focus on the initiation of the project, the selection of project sites and participants (small-scale farmers), and the field trials undertaken on the selected plant species.

3.1 Project context and history

Food security for rural households has been shown to be the most urgent aspect of social well being in the Transkei and more particularly, in the villages in and around Alice (Monde 2000).

Studies by ARDRI indicated that the measure of widespread poverty impacted very negatively on living conditions and specifically on the nutritional status of households. Poverty⁵ is regarded as a central cause of hunger and malnutrition (Monde 2000:6). Natural disasters, but also certain policies promoting single crop specialisation, are viewed to be some of the main reasons for food insecurity in rural areas. Agricultural development is often planned as part of economic development. Farmers are often encouraged to grow crops that will increase returns (economically) per unit of land. This has, however, often leads to specialisation and a limited range of crops. This, in turn, has a negative impact on the nutritional status and balanced diets of rural communities.

The wide variety of foods used in many traditional diets tend to be lost as agricultural specialisation is encouraged and wild vegetables disappear. A nutrition-oriented development approach should be encouraged if hunger and poverty are to be alleviated. (Monde 2000, 6)

A study on small-scale farming undertaken in 1996 by ARDRI on behalf of AGRILEK⁶ indicated that many people in the Transkei are still involved in farming as a source of livelihood and income (**ARDRINEWS**, July and December 1998). In this study, findings showed that small-scale farming was still alive in the Transkei (**ARDRINEWS** 1998:4) but that farming in the Eastern Cape showed unique characteristics and faced major obstacles for further development. The study also showed that in a region with relatively good climate, water supplies and soils, the agricultural potential remains high. Small-scale farmers are keen to progress, but major improvements are needed in infrastructure and support systems to facilitate further development. Farming still has the potential to provide the required minimum nutritional balance as well as contributing towards the economic activity of the communities.

Against the background of food security, taking the results of previous studies on poverty and nutrition into account, ARDRI embarked, in collaboration with ICUC, to re-establish

⁵ If the demographic data of the Nkonkobe municipality (in which the target villages are situated) is studied (Appendix 1), it is evident that low income and poverty are two features which have a significant impact on the well-being of these communities. A total of 94 894 (66% of the total population in the municipal area) respondents indicated no income at all.

⁶ A division of ESKOM focusing on the optimisation of electricity usage in agricultural contexts.

some of the traditional vegetables that were known and utilised in the area. The reasons for selecting traditional crops were mainly because of the nutritional value of the vegetables and the particular traits of drought and pest resistance.

In most cases, the energy available per person was below the dietary recommendations with vegetables contributing less than 5% to total energy (Peter & Ngwandla 2001:2).

It is because of the food security that ARDRI also focus upon (the vegetables) because we want to improve the quality of life of the people. (Phatekha Peter, interview, October 2003)

Three traditional vegetables were chosen, namely *Amaranthus* spp. (Utyuthu), *Plectharanthus* spp. (Inongwe) and *Cucurbits* spp. (Ithanga).⁷

The domestication of indigenous vegetables project started in 1997 when discussions about the domestication of traditional and indigenous vegetables got under way between the Faculty of Agriculture and the International Centre for Underutilized Crops (ICUC) in the United Kingdom.

[The ICUC] came with the idea to use the indigenous crops. They said that there were crops that can be used like the Cucurbits, the Plectharanthus and the Amaranthus, which are available. But they said we can develop the project and come up with other ideas. (Phatheka Peter, interview, 20 October 2003)

Ms Phatheka Peter got involved in the project during 1998 and took over full responsibility as project leader in 2000 when the previous project leader left for another position. At that stage, the project was moved from the Faculty of Agriculture and Environmental Science to ARDRI from where it was managed afterwards.

3.2 Project aims

The core focus of the project was the introduction and communication of the project and the supply of the seed to small-scale farmer participants in three selected villages. The project goal was defined as: "...the domestication and evaluation of three African vegetables and their potential for improving the nutritional status of rural diets" (Peter 2001:2). Linked to this was the delivery of practical assistance and management of farming processes, linked to the vegetables, by the project manager, Ms Peter. Assessing the attitudes and perceptions of the local communities towards the traditional/indigenous vegetables would conclude the project.

As a secondary goal of the research, it was envisaged that by increasing vegetable production, small farmers would be able to sell some of their produce and generate additional income to their families. As Ms Peter explained:

It was both commercial and food security, because for food security reasons I wanted them to have food available, but they could also sell the vegetables if they had enough. (Phatheka Peter, interview, 20 October 2003)

⁷ Ultimately, *Plectharanthus* did not show enough promise to be continued in the village trials, and *Cucurbits* and *Amaranthus* were the only indigenous vegetables planted by small-scale farmers.

3.3 Project team and funding

Originally two researchers were involved in the project, the project leader and a research assistant. The assistant was later transferred to another project with the result that the project leader, Ms Peter, took sole responsibility for the project.

Primary funding for the project came from ICUC, while the Eastern Cape Department of Agriculture (ECDA) also contributed funds annually. The project grant was relatively small, amounting to less than R50 000 per year. This had the effect that only a limited number of researchers and technical assistants could be used (Phatheka Peter, interview, 20 October 2003). The research cycle funded by the grant spanned a period of five years. The first two years of the project were at the Faculty of Agriculture (Fort Hare) while the last three years were at ARDRI.

At the time of the interview with Ms Peter (October 2003), a continuation of the ICUC-funding has been requested with the aim of extending the project to other communities.

We would like to find some other funding. We are putting a document together, we submit it to the Department of Agriculture. We say, this is what we've done, and this is the potential for this project. So we need funding so that we can try to repeat what was done here at other places. Now we would like to find out how do people perceive it elsewhere, because we will have to generalise and say it works. We cannot do this based on the results of only three villages. (Masika, interview, 2003)

3.4 Project description

Seed trials

The first phase of the project focused upon the evaluation of the seed. The first seed trials were undertaken on the University of Fort Hare experimental farm while the project was still at the Faculty of Agriculture. The seed was evaluated according to specific criteria, such as germination ease and percentage, yield, taste and so on.

When the project was transferred to ARDRI during 2000, further seed trials were conducted on seed obtained from the Department of Agronomy at the University of Fort Hare. The second trials focused specifically on the *Amaranthus* spp. These seeds were also planted at the University' research farm. Eight strains were evaluated focusing on undesirable characteristics such as the colour of the leaves or the presence of spines in the leaf axel (Peter & Ngwandla 2001). Evaluations according to yield performance under various planting methods and taste preference were also done. General agronomic qualities such as drought and pest resistance were also evaluated. Based on the trials, three accessions were selected for further use in the study. At this stage, ARDRI was mandated by ICUC to do multi-location trials for the *Amaranthus* spp. to determine its acceptability with the rural people. These multi-location trials are discussed later in this section.

Towards the communities

An important aspect of the research process was the recognition of the time-honoured social structures present within communities. The role of the chief or chairman of the villages as community leader had to be recognised in securing the approval and acceptance

from the villagers. The project leader therefore held discussions with the relevant leaders in explaining the goal and praxis of the project. As Patrick Masika explained:

Before we get involved again, we need to go again to the structures in the communities, be it the chief or the committee, to tell them that we have been requested to become involved in such an activity or we're interested in doing this activity in their community and would like to be introduced to the community. So we attend a meeting where we are introduced and explain our idea. (Patrick Masika, interview, 22 July 2003)

Thereafter, the project was taken to the villages and discussed with the community. Some expressed their willingness to take part in the project. The project leader then randomly selected the required number of small farmers.

The research project aimed to establish a procedure for the re-incorporation of the indigenous vegetables in the seasonal vegetable planting practices of small farmers in the villages. After the introductory and explanatory phase of the project to the three communities, important elements of the further project showed to be:

- ◀ Selection of farmers to take part in the project
- ◀ Training of participants and overseeing the planting, harvesting and seed retention process (drying and storing)
- ◀ Fortnightly visits by the project leader to participants to assist them during the different stages of the planting and harvesting process
- ◀ Assessment of community perceptions of and responses to the indigenous vegetables
- ◀ Assessment of the impact of incorporating indigenous vegetable into existing home gardens competing with vegetables such as maize, potatoes, different varieties of pumpkin, spinach, etc., and
- ◀ Assessment of the wider economic impact of the indigenous vegetables.

The selected villages were well known sites for ARDRI.⁸ Originally, when starting with irrigation projects and school gardens, these villages were identified and proposed by ECDA extension officers.

We went and told them we would like to do this project. And they said, now, we think that could be a better community, because they fall in different districts. Although you'll find in Nquka, I think, depending on what you're working on, it's got difficulties here and there, people not cooperating, etc. I'll say on average we had good working relationships with the communities. (Patrick Masika, interview, 22 July 2003)

⁸ Villages were chosen where ARDRI was previously involved with different projects. These projects formed part of the wider research portfolio of the Institute focusing on development through agriculture. Previous projects include: "Multi-Directional Communication for Irrigated Community Gardening" (Roxeni, 1998); "Forage and other contributions of arable land allocations to cattle production in two villages" (Guquka, 1998); "Rural livelihoods in the Central Eastern Cape" (Guquka, 1998); "Poverty in Guquka and Koloni" (1999); "Gqumahashe agricultural development project" (1999); "Rural people's diets, insufficient or unbalanced?" (Guquka, 2000); "Crop production and other contributions of arable land allocations in two villages of the Central Eastern Cape" (Guquka, 1999).

Map of the Eastern Cape province



After the introductory and information phase described above, the next phase was the operationalisation of the trials in the villages. The multi-location trials of *Amaranthus* and *Cucurbits* are discussed below.

Nkonkobe Municipal boundaries (dark blue) in which the three villages Guquka, Lower Gqumahashe and Roxeni are situated



*Multi-location trials of Amaranthus*⁹

Amaranthus refers to a number of plants that have tassel-like heads of small green, red or purple flowers. The plant is very similar in appearance to spinach. Its large leaves are the main part of the plant that is used for cooking.

Box 1: Perceptions of Amaranthus

Lack of knowledge of the potential of the vegetable as a source of high nutrients in their diets had led farmers to have a passive attitude towards the plant. Historically, women only ate Amaranthus. The Xhosa people believed that men who ate the plant would become effeminate (Peter 2001:5), or that it might lead to insanity. According to Zozipho Gotshana (interviewed in 2003), folklore prohibited a man from eating Amaranthus. In the olden days, it was said that a woman must not eat an egg and a man must not eat Amaranthus. With time these beliefs have changed due to hardships such as food scarcity, with the result that everybody started to eat Amaranthus without side effects.

Two villages where ARDRI had worked in the past, namely Guquka and Gqumahashe, were selected for these multi-location trials. Planting the seed in these villages rather than at rural farms had the benefit that perceptions were more positive towards the species. Farmers viewed Amaranthus as a weed and would frown upon being requested to participate in propagating it.

Results of the Amaranthus trials were categorised according to the following criteria:

- ◀ Yield evaluation
- ◀ General performance (plant height, leaf size, leaf colour intensity and insect damage)
- ◀ Taste, and
- ◀ Comparison of planting methods (direct sowing versus transplanting).

The difference in plant height and leaf size was monitored between different accessions planted at the two sites. A meaningful difference in yield was noticed between the two trial sites but was linked to the difference in rainfall: Guquka is located in a higher rainfall area (700-800mm) than Gqumahashe (400-500mm).

⁹ Concurrent with the multi-location trials, a seed multiplication exercise for Amaranthus, Plectharanthus and Cucurbits was carried out at the University of Fort Hare Research Farm.

Ms Peter making observations of Amaranthus plots at Gqumahashe



(**ARDRINEWS** July 2001)

Trials at both villages showed that the plants were very robust against insects. Only one of the accessions had severe insect damage while the other seven accessions were either only slightly or not at all damaged.

Amaranthus from the different ascensions were given to the farmers and some friends to taste. In most cases it was found to be tasty and ideal for eating. Only one of the accessions (F) was found to be bitter and should, when used, be mixed with other products such as maize.

Trials were done to determine the best practice of establishing Amaranthus, either by sowing or planting. Eight farmers were selected in each village. Four of the eight farmers sowed the seeds directly to the bed and thinned out to 15cm at the three-leaf stage, while the other four farmers were supplied with seedlings from the project manager. These trials were to evaluate the best planting method that would be the most practical and appropriate for the small-scale rural farmers.

Direct sowing of the seed was found to be the recommended method because farmers do not have the necessary facilities for transplanting seed established in seed trays. Direct sowing needed little or no attention after sowing, while transplants needed constant attention until they finally established themselves after a month. Weeding, however, was easier with transplants because they were not as densely planted.

Different harvesting methods were also tested. One half of the farmer groups would harvest according to need, while the other half would only harvest at intervals of between 3-4 weeks when the plants would be cut back to a height of 30cm. These trials were aimed at evaluating the effects of harvesting method on plant development and taste. No difference in taste was documented because of the different harvesting methods. It was found that, in some cases, when harvesting of the leaves was not carefully controlled, the production of seed by the plants was compromised with the result of lower availability for the next season.

In conclusion, the trials were important because they charted a course for best practice of the practical aspects of planting, harvesting, drying and so on, while consumer acceptance was also evaluated. The trials demonstrated that the small-scale farmers mastered the farming practices related to the vegetables without any problems and that the community showed positive attitudes towards the edible parts of the *Amaranthus* plant.

Multi-location trials of Cucurbits

Cucurbits include any of a family of creeping flowering plants, such as the pumpkin, cucumber and gourds.

Box 2: Perceptions of Cucurbits

In the survey, a large percentage of respondents (78%) were not aware of any traditional belief that prohibited them from growing Cucurbits. Only a small proportion (17%) of respondents had a traditional belief that very high cucurbit yields was a sign that somebody close to the producer was going to die. This myth, however, did not prohibit participants from producing as many Cucurbits as they could. Respondents did not know any medicinal use of Cucurbits for people and/or animals.

Assessment trials for Cucurbits were conducted according to the same criteria of domestication and acceptability, as was the case with *Amaranthus*. The Cucurbits trials were conducted at the villages of Gqumahashe, Roxeni and Guquka. These villages are all located within the boundary of the Nkonkobe Municipal area. The project leader using a structured questionnaire interviewed 56 respondents.¹⁰

A selection of Cucurbits stored for later use



Source: Webpage ICUC (<http://www.civil.soton.ac.uk/icuc/>)

¹⁰ See Appendix 2.

Participants were given different varieties of Cucurbits to taste and during the interview they were shown pictures of the Cucurbits. They were asked to choose the varieties they liked and had to give reasons for their choices. Some of the reasons they gave included: sweet taste, not being watery when cooked, big size, high yields and dark colour. The dark varieties were said to be tastier and more drought resistant than the lighter varieties.

Respondents mainly grew Cucurbits for home consumption. Planting occurs in August/September, which was said to be a suitable time for Cucurbits in the survey area. About half (48%) of the farmers had obtained the seeds from relatives and friends, while the rest had used seeds retained from previous harvest or bought seed. Most respondents (76%) said improved seeds¹¹ gave better yields compared to the ones retained from previous harvests.

Farmers did their planting by hand using hoes – a method they said was the most reliable for achieving higher yields. Respondents did not use chemical fertilisers in the planting of Cucurbits – they either used manure or nothing at all because they found chemicals too expensive to purchase. Various methods of applying the manure were used: applying a small portion of kraal manure, during planting, in a hole before putting in the seed (46%); applying it during land preparation (26%) and the rest (28%) had applied it in the previous years. Some of the reasons mentioned for using manure were: it improves yield and quality of a crop; it maintains soil fertility, keeps moisture in the soil and heats up the soil to prevent some pests.

The common pests and diseases mentioned were pumpkin fly and mildew, respectively, which lower both yield and quality of the crop. Farmers complained of lack of money to buy pesticides, though some managed to buy a relatively cheap chemical called ‘blue death’, which is applied on the Cucurbits leaves. Other farmers had opted for utilising the readily available resources such as ash (which they sprinkled evenly over the leaves of Cucurbits to prevent pumpkin fly) or soaped water (to trap and kill insects).

Farmers kept their Cucurbits on top of the roof or stored them in cool rooms on wooden crates to prevent them from rotting. These seeds were normally removed during the preparation of the Cucurbits for cooking, where they would in the normal course of practice be taken out and spread out to dry. After drying, these seeds are then stored in plastic, glass or tin containers to prevent them from being eaten by rats. These seeds are then used in the following planting season.

¹¹ The idea of “improved seeds” raised the question if any genetically manipulation was used in the research process. In questioning Ms Peter about the reference to improved seeds, she stated that it did not refer to any process of genetic manipulation, but rather to seeds supplied by herself instead of seeds dried by small farmers after having been sourced from crops in Alice. While the project was still at the Faculty of Agriculture, the genetic improvement of the seeds was considered, but did not materialise. Seeds were then sourced from areas of its natural location in the Transkei. (Peter, interviewed 2003)

The market value of Cucurbits was largely determined by their physical appearance (size, shape, maturity and occurrence of blemishes and decays). The price ranged from R5 to R15, depending on the size. Farmers sold their produce within their communities, to neighbouring villages and to the public in the town of Alice (between 20 and 80km round trips to the study sites). Depending on the demand, selling a dozen Cucurbits would take participants anything from 3 days a month.

At the end of the project, it was evident that perceptions towards Cucurbits were positive amongst villagers and that usage has increased. Seed was in demand and there were indications that more and more people were interested in including Cucurbits as one of the vegetables in their gardens. Villagers have also expressed their preference for the orange variety, although the others were also planted. They liked preparing Cucurbits like ordinary pumpkin, either with or without sweetening it with sugar.

In conclusion, the production of the cucurbit varieties has the potential to contribute to the food security of the farmers, and to generate some income for the rural people. Cucurbit production could increase the range of crops grown for family's own consumption since most of these varieties are resistant to pests and drought. There will be interventions based on the results, designed to improve productivity, so that production can move from a subsistence basis to a more marketable one.

3.5 Project outputs and deliverables

Reporting by the project manager on the process and findings of the project on the domestication of indigenous vegetables was done in the form of research reports published in **ARDRINEWS**. The research results on Amaranthus were published in **ARDRINEWS** of July 2001 while the results on Cucurbits were published in **ARDRINEWS** of July and December of 2002.

The small farmers were the main beneficiaries of the research. The project also generated a lot of interest from other people like neighbours and friends.

I could see that the people in the villages planting the vegetables and that the people in the markets around would buy it. Also that the idea would be developed into other villages. [] The interest is growing. The neighbours are also interested and ask about it. They get seeds from friends and from me. (Peter, interviewed 2003)

Box 3: Local impact

During the two years in which the multi-location trials on Cucurbits and Amaranthus were implemented in the villages, it was evident that the project has generated enthusiasm and interest and that more and more villagers wanted to include these vegetables into the "basket" of vegetables that they plant annually. The selected farmers also continued planting these and generated more seed every year with the result that they could extend the area planted under Amaranthus and Cucurbits.

3.6 Reaching the research aim: A project manager's perspective

The project rationale or theory was highlighted earlier in this report; namely, that if indigenous vegetables, which are more pest- and drought-resistant than domesticated vegetables, can be re-established in the community on a wide scale, this will contribute towards higher levels of food security and economic activity. These vegetables will also improve the nutritional status of rural communities' diets.

The first phase of the project, namely sourcing the seed and establishing the indigenous vegetables in selected villages, has been concluded. Wide interest from other small-scale farmers in adjacent villages calls for further management involvement from ARDRI. However, owing to the termination of funding, this has been put on hold. In addition, the project manager, Ms Peter, has since left the services of ARDRI owing to limited funding, and joined Umsobomvu Development Consulting in Queenstown.

Additional areas where need was expressed included post-harvest technology, that is, research into drying and conserving techniques to extend the vegetable usage into the winter months.

The project manager expressed her conviction that the project has contributed in a meaningful way to food security and the improvement of the nutritional status of households. The specific traits of drought and pest resistance as well being tasty when cooked, contributed to the wide acceptability of the vegetables in the selected communities.

It is valuable to them. I am mostly concerned with the small farmers but not with the commercial farmers. The value of the research is that it has improved the situation of food security as well as the commercial advantage for small farmers by selling the vegetables. [] Because I see the interest in the villages grow and more and more people are planting it. Also we can see the effect of kraal manure on the indigenous vegetables. (Peter, interviewed 2003)

A research proposal was drafted by ARDRI and submitted to ICUC during 2002 to request further funding in order to continue the research into the wider re-establishment of indigenous vegetables. Interest was also expressed by the ECDA to extend the project to other villages. At the time of the interviews with Ms Peter, no conclusion had been reached regarding the expansion of the project, and additional funding was not yet secured.

4 The mode and contexts of knowledge utilisation

The author conducted interviews with ten small-scale farmers participating in the project, in order to elicit further information about how the research/trial results were being utilised in the three villages. Three interviews were conducted in Guquka, three in Lower Gqumahashe and four in Roxeni.¹² (See Appendix 3 for the questions posed to small farmers at Guquka, Lower Gqumahashe and Roxeni.) Owing to the fact that the farmers interviewed are all Xhosa-speaking, the project leader, Ms Phatekha Peter, offered her services as a translator, and accompanied the researcher to the

¹² See "Data sources" for further details of these respondents.

different sites. The interviews were conducted in English and, while in some instances it was evident that participants could understand English, in all cases they responded in Xhosa through the translator. Because of the constraints imposed by translating the responses from Xhosa to English, these are summarised into a more general response and quotations are not used verbatim.

In the following section, each of the three villages are considered as sites of utilisation, and an overview of the perceptions and experiences of some of the small-scale farmers with regard to their participation in the project is provided.

4.1 The utilisation sites: Lower Gqumahashe, Guquka and Roxeni

Lower Gqumahashe

The year 1997 was a difficult one for many employees of the University of Fort Hare's service division. The University embarked on its restructuring programme, which resulted in most of the service workers being retrenched during the same year. Many of those laid off did not get re-employed. Instead, they went back home to their villages where they were without work and, in many cases, without the necessary means to support their families (Mavu & Ngwandla 1999).

The difficult circumstances in which those retrenched found themselves forced them to think of alternative ways of alleviating the high unemployment and poverty levels in Gqumahashe. Agricultural projects were the first option, since the village had land, some of which they had lent to the University for years.

In order to proceed with their plans, funding was needed. The Faculty of Agriculture and ARDRI were contacted to assist in drafting a project business plan and application for funding. Although the project initially emphasised vegetable production mainly, it was later decided that individuals interested in other sectors of agriculture should also be given the chance to become involved. As a result, the project includes not only irrigated vegetable production, but also components of chicken (broilers and layers) and pig production.

ARDRI approached the Canon Collins Educational Trust for Southern Africa (CCETSA) for financial backing to establish this project for food security.

The project management formed by the community comprises a board of seven members, who are responsible for running the project. The three interest groups include irrigation plots (41 members), chickens (40 members) and pigs (20 members). Each of these interest groups has a subcommittee of three members, who, together with the board, form the management team of the project (Mafu & Ngwandla 1999).

Ms Phatekha Peter was the project co-coordinator of the Gqumahashe development project on behalf of ARDRI at the time of the case study interviews. She is, however, also the project leader for the project on the domestication of indigenous vegetables, and as such had a good working relationship with the farmers at Gqumahashe. This led to Ms Peter extending the project on indigenous vegetables also to Gqumahashe. Eighteen small farmers are taking part in the establishment of African vegetables at Lower Gqumahashe. At the time of the interviews (October 2003), every family or farmer was allocated ½ha

but will, later on, when the new additional development has been completed, get Iha to work. The participants are currently planting Cucurbits and Amaranthus.

Guquka and Roxeni

The farmers at Guquka do not have an irrigation system, but are dependent on rain only. They therefore practice “dry land” agriculture. In this village, the farmers only planted the one vegetable, namely Cucurbits. Fifteen people are taking part in the project.

Twenty-three people are taking part in the project to establish indigenous vegetables in Roxeni. In this village, the project is a co-operative initiative developed with joint financial backing from the International Development Trust (IDT) and Novartis Masakane Community Project. The wider agricultural goal is to include sheep, goats and vegetables in the activities of the co-op. The vegetable land is situated next to a dam and irrigated from the dam by electric pump and a sprinkler system.

4.2 Farmers’ preferences and perceptions

Before the introduction of the indigenous vegetables to the villages, farmers planted the well-known and popular vegetables such as spinach, onions, cabbage, potatoes, carrots, beetroot and maize. They did not know the indigenous vegetables prior to the introduction thereof by ARDRI and the project leader. Some of the smaller varieties were known but the particular varieties were new to them. In some instances, villagers knew that the “old people” planted these. According to the project leader, Ms Peter, the Amaranthus was seen as a weed and not an edible product.

It was not beliefs. But they took them as weeds. And they were not familiar with the Amaranthus that I have brought to them. They were familiar with the ones that are even smaller and the one that I brought is the bigger one; it originated from the Transkei. (Peter, interviewed 2003)

Villagers in the three villages and experimental sites planted Amaranthus and Cucurbits. These were integrated with other vegetables such as potatoes, carrots, beetroot, cabbage, butternut and spinach in their gardens. In all cases, the small farmers have participated in the project for two seasons already and were planning to plant again in the forthcoming season (November 2003).

The selected small farmers in the three villages expressed their satisfaction with the incorporation of the indigenous vegetables into the “basket” of vegetables that are grown by them. All the aspects that were important to them such as ease of use, performance (drought and pest resistance), edibility and acceptability amongst fellow villagers (for selling purposes), were present during the two years in which Cucurbits and Amaranthus were planted. This had the result that the continued usage of the indigenous vegetables was established and promised to expand with every season, dependent on the availability of seed. It was therefore evident from interviews with villagers, that they have incorporated relatively unknown varieties (even against previous perceptions about it) of vegetables into their planting practice and are eager to continue doing so in future.

Small farmers expressed preference for the dark orange coloured Cucurbits with the yellow flesh during interviews, stating that they were tastier and not as watery as the

other varieties. However, the other varieties were still planted and used in meals. One of the reasons given was that not enough seeds of the orange coloured one were available with the result that they also had to use the other varieties.

With regard to a preference for *Amaranthus*, farmers expressed their first choice to be the dark green variety. Others were, however, also eaten.

Reasons for planting the vegetables varied. For most farmers, the *Amaranthus* provides an important source of green vegetables for cooking. The plant is drought- and pest-resistant, and responds well to rain with good growth over a short time. The *Amaranthus* also provides a good quantity of food and requires little maintenance.

Varied views were expressed regarding perceptions of health advantages because of eating the indigenous vegetables. Some interviewees were not aware of any specific health advantages, while one interviewee, Ms Zozipho Gotshana (interviewed 2003), stated that it is beneficial for diabetes.

All interviewees stated that they are going to plant the vegetables again during the coming season (the third year after initial introduction). The majority indicated that they are extending the area planted under indigenous vegetables every year. The determining factor, however, is the availability of seeds.

Perceptions of the broader community

The interviewees reacted unanimously positive on the question of the response from the wider community, neighbours and friends who were not directly involved in the project. Neighbours and friends liked receiving the vegetables and cooking it for their families. They often inquired about the seed and would like planting the vegetables.

4.3 Training and support from the project manager

The project manager provided support to the small-scale farmers, from the initial stages of information meetings and workshops, right through to harvesting and drying of the seeds. Ms Peter visited the farmers regularly (fortnightly) to manage the different phases of the project:

We improve the knowledge of the farmers by training. We sometimes do workshops. Normally we give them the topic. We talk about the topic and they ask questions on things that they do not understand or know. We showed them and trained them how to sow and plant the seeds. We visited the farmers fortnightly. It was not only the seed that was sourced and distributed in selected villages to selected small farmers, but the training and consultation was also important aspects of the project. (Peter, interviewed 2003)

The interviewees acknowledged the help received from the project leader and indicated the importance of her presence during the growth season at regular times. In the areas of planting, taking care of the plants (watering, pest control, etc.), harvesting and drying of the seeds, small-scale farmers received practical assistance from Ms Peter during the course of the two planting seasons.

They did not experience any particular problems with regard to any area of the production cycle of the vegetables and stressed the fact that it was not difficult to plant, harvest and dry the seeds of these vegetables.

4.4 Different practices

Soil preparation practices

Interviewees indicated different methods of preparing the soil. Most are using cattle manure because of its availability, while others indicated that they are also using compost. Some farmers use manure at the planting spots at the time of planting, while others apply it to the plant rows later.

Post-harvest practices

Farmers did the drying of the seeds very similarly. The seeds were spread on a flat surface, allowed to dry in the sun (on a roof) and then stored was followed by most of the farmers. Farmers used variety of containers to store the seeds such as glass, plastic, a tin, clay, etc., usually in a cool place. With regard to *Amaranthus*, the leaves are harvested as required, but some are left on the plant for the production of seed.

Post-harvest technology

Farmers expressed a problem with the cyclical aspect of the over and under supply of vegetables. Currently no post-harvest technology such as the drying of vegetables for later use is available, with the result that a high and low supply of vegetables is experienced. During the summer months an over-supply of vegetables is experienced when families, particularly those who does not have land under irrigation available, propagate enough for own consumption and even for selling. During winter months an under-supply is again experienced. Research and technology in drying and conserving of vegetables are needed. The project leader did express the need to expand the project into researching post-harvest methodologies, if funding could be secured.

Personal use and cooking of vegetables

Interviewees indicated that the own use of the vegetables is the main reason for planting it. Particularly with the *Amaranthus*, it is planted mainly for own consumption, and, in cases where enough is produced; it is also given to the neighbours. It is mainly the Cucurbits that has a commercial value and therefore sold. The dark one (dark yellow inside) was very popular and sold well.

Interviewees mentioned varied methods of preparing the vegetables. Methods of preparation differed between *Amaranthus* and Cucurbits. *Amaranthus* was experienced to be very similar to spinach, but tastier. The leaves of the plant are cooked. Some interviewees stressed the fact that the children liked the *Amaranthus* very much (Ms Gladys Tshoko, interviewed 2003). Cucurbits are prepared in a similar to pumpkin, adding sugar in some cases, particularly with the bitter varieties. Maize meal or samp is also used in the same dish and mixed with Cucurbits by some cooks. Most of the Cucurbit varieties are sweet and tasty. It is also sometimes mixed with rice. In some cases it is fried in oil or butter.

4.5 Selling the produce

Interviewees stated that mainly the Cucurbits are being sold. Amaranthus are mainly used by them or given to friends or neighbours. One of the interviewees (Ms Gladys Tshoko, interviewed 2003) stressed the fact that people liked the Cucurbits very much and that she plans to plant more during the next season with the aim of selling it.

5 Concluding comments

Over a period of five years the project on the domestication of indigenous vegetables has completed a full cycle, from the sourcing and testing of seeds, through multi-location trials, to a situation where small farmers have incorporated these "new" vegetables from the past into their seasonal vegetable gardens. Attitudes and perceptions amongst inhabitants of the particular villages which were involved in the research, changed from ignorance and even opposition (for instance, in cases where Amaranthus was regarded as a weed) to enthusiasm about the properties and the edible qualities of the vegetables.

On a broader level, the project contributed in a meaningful way to food security and the alleviation of unbalanced diets and diet-related illnesses in the Alice area – a stated priority area of for the national Department of Agriculture:

Sustainable development is of utmost importance to South Africa as a developing nation. This includes achieving food security from household to national level and integrated sustainable rural development as part of overall economic development. (April 2002, Strategic Plan for the Department of Agriculture, 2002- 2005)

The Eastern Cape Department of Agriculture has expressed interest in extending the research to other villages.

It was ARDRI's well-established relationship with rural communities in the Alice area, and a track record of other development projects, in particular, that has contributed to the take up of the research in the three target villages. The success of the project can be attributed to a high level of trust from the side of the small-scale farmers with regard to the presence and work done by ARDRI amongst them.

The production of knowledge through this project can be categorised as applied research. The research approach resembles that of an experimental design methodology, with the multi-location trials as the most central element of the research. In terms of pre-testing and post-testing in the experimental design, the seed trials at the Fort Hare experimental farm can be regarded as the pre-testing, while the multi-location trials and the continued incorporation of the indigenous vegetables into small farmer vegetable planting practices, might be seen as part of a continuous post testing exercise.

The research and the agricultural development objectives of the project are not always clearly distinguishable and tend to interlink and shift between research and development. This is probably to be expected with an institute such as ARDRI, whose main goal is to further agricultural and rural development through research activities. The expressed goal of the project was of a developmental nature, contributing to food security and improving the dietary status of rural households.

Utilisation of the research by small farmers took place on two levels: firstly the availability of the vegetable seed that was the result of seed trials (assessment and multiplication) at the University of Fort Hare's experimental farm; and, secondly, the implementation of planting, tending, harvesting and drying practices according to the leadership and training provided by Ms Peter, the project leader. Utilisation during the first two seasons during which the multi-location trials took place, was therefore closely managed and monitored by the project leader, who also was the transfer agent of the research. Utilisation also had a research element to it because comparative assessment of the different varieties within the three vegetable species was undertaken in the three villages.

The multi-location trials at the selected villages formed a bridging activity between the research and utilisation aspects of the project in that the selected seed was provided to the small farmers for incorporation into their gardens. The assistance rendered to the small farmers by the project manager during this phase, resembles that of agricultural extension with the aim of furthering the smooth uptake of the vegetables into seasonal vegetable planting practices. The project leader's close collaboration, on a regular basis, with the small farmers during two planting seasons, established a base from where positive attitudes with regard to the indigenous vegetables could be build.

The research (seed trials), and utilisation (multi-location trials) are closely linked and continued through a process by which the small farmers are exercising their own preferences in the further selection of the varieties they choose to plant, based, amongst others, on taste preferences.

Regarding the impact of the research on development through food security, the research was successful in that it did contribute to improving the availability of vegetables with high nutritional value to villagers. Interviewees stated the fact that they had more green vegetables available because of the fact that the Amaranthus plant, in particular, tends to have a short cycle of regrowth after being harvested. The ease of tending to the vegetables and the traits of being drought- and pest-resistant, were also singled out by interviewees as reasons why they are enthusiastic about including these into their vegetable gardens for seasons to come.

One aspect of concern, however, was the reality of high food production during summer months and scarcity during winter months, particularly in villages where regular supply of water for irrigation purposes was not available. Post-harvest technologies focusing on extending the availability of vegetables into the winter months, were urgently needed.

5.1 Key observations and lessons learnt

Firstly, it is evident that different forms of collaboration ensured the success of reaching the goals of the project:

- ◀ Collaboration with the communities through the traditional leadership structures was vital for the success of the project.
- ◀ Regular contact with the funding agents ICUC and the Eastern Cape Department of Agriculture ensured that the project was managed on a high level and progress reports were issued regularly.

- ◀ Academic collaboration with colleagues at developmental research units and visits by overseas researchers to the ARDRI contributed positively to the research.
- ◀ Collaboration with non-governmental organisations proved to be important in reaching the development goals of the project.

Secondly, utilisation took place on different levels according to the constituency taking up the research results:

- ◀ Utilisation on the level of agricultural development did take place in the building of capacity and the advancement of knowledge and know how of small-scale farmers with regard to particular indigenous vegetables.
- ◀ On the academic level, the research outputs were shared with colleagues and students during seminars and the in-house publication, ARDRINEWS. Indirectly, students at the Faculty of Agronomy (UFH) also benefited by the project by being exposed to the multi-location trials and the value of the indigenous vegetables to development.

Finally, Ms Phatheka Peter, the project manager, was the only knowledge transfer agent.

Data sources

Face-to-face interviews

Patrick Masika (Head: Agricultural and Rural Development Research Institute, University of Fort Hare), 2 February 2001 and 22 July 2003

Ten farmers from three villages in the Alice district of the Eastern Cape were randomly selected for short interviews. These include:

- ◁ Guquka village: Mr Msizi, Mr William Pazi and Ms Zozipho Gotshana
- ◁ Lower Gqumahashe village: Mr James Ntsedwana, Ms Gladys Them bani and Ms Gladys Tshoko, and
- ◁ Roxeni village: Ms Virginia Mlumbi, Ms Gertrude Mlumbi, Mr Maxwell Xabanisa and Mr Philemon Mlumbi

Telephonic interview

Phatheka Peter (Project manager, The Domestication of Indigenous Vegetables, ARDRI), 20 October 2003

Email responses to additional questions

Phatheka Peter, 9 October 2003

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Appendix 1: Demographic data for Nkonkobe Municipality, Eastern Cape

General		Annual Household Income	
No of Households	28635	None	4337
Population		R1-2400	2954
African	136163	R2400-6000	7838
Coloured	4537	R6001-12000	5348
Indian	83	R12001-18000	2425
White	1776	R18001-30000	1501
Other	608	R30001-42000	699
Gender		R42001-54000	544
Male	68064	R54001-72000	406
Female	75022	R72001-96000	273
Age Breakdown		R96001-132000	245
0-4	12849	R132001-192000	154
5-19	53516	R192001-360000	85
20-29	25117	Over R360000	33
30-49	27504	Unspecified	1676
50-64	11653	NA	117
Over 65	11361	Telephone Services	
Age Unknown	1153	Dwelling	2622
Employment		Neighbour	3379
Employed	13861	Public Phone	7466
Unemployed	21321	Other Nearby	1045
Employment_Unspecified	182	Not Nearby	2418
Under15	47928	No Access	11413
NA	9717	Institution Premises	89
Industry		Institution None	14
Farming	1594	Telephone Unspecified	189
Mining	210	Electricity	
Manufacturing	730	Local Authority	6251
Utilities	132	Other	132
Construction	738	Gas	317
Trade	1135	Paraffin	20917
Transport	517	Candles	821
Business Services	376	Electricity Other Source	0
Social Services	5322	Electricity Unspecified	197
Private Household	2093	Sanitation	
Exterritorial	0	Flush	2511
Diplomatic	7	Pit Latrine	19186
NEC	1765	Bucket Latrine	3406
NAI	119495	None	3356
Institution	9717	Unspecified	176
Annual Individual Income		Water	
None	94894	Water Dwelling	3098
R1-24001	2772	On Site	2802
R2401-6000	16897	Public Tap	13136
R6001-120001	5322	Tanker	639
R12001-180001	2173	Borehole	1226
R18001-300001	1641	Natural	7523
R30001-420001	1042	Other	45
R42001-540001	729	Unspecified	166
R54001-720001	609		
R72001-960001	246		
R96001-1320001	147		
R132001-1920001	61		
R192001-3600001	27		
Over R360000	25		
Unspecified	6770		
NA	9719		

Source: Municipal Demarcation Board, <http://www.demarcation.org.za/>

Appendix 2: Questionnaire: assessment of diversity, production systems and selection of cucurbits for improvement

Name of respondent	
Date	
Village	
Questionnaire number	

Demographic information

1. How many people live in this household?

2. Please provide the following information about your household

Relation to HOH	Age	Gender	Highest educ. qual.	Employ. status

3. Which of these Cucurbit varieties have you ever eaten/seen or do you know?

Variety	Local name	Seen	Know	Eaten	Taste	Preparation
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

4. Can you provide us with the following information in the table below

Which of these varieties do you usually grow	Reasons of growing them	When do you usually grow them

5. Do you use manure for growing Cucurbits? Yes No

6. If yes, when do you apply it and in what quantities?

7. Do you use fertiliser for growing Cucurbits? Yes No

8. If yes, when do you apply it and in what quantities?

9. Do you think manure or fertiliser helps Cucurbits to grow better? Yes No

10. Give reasons for your answer

11. Can you provide us with the following information in the table below on diseases and pests which affect the Cucurbits?

Diseases	Control	Pests	Control

12. Which part of Cucurbit plant do you use and for what purpose?

Part	Use

13. What do you do with the produce? (consume/ sell, or donate)
14. If you sell the produce, how much is the price/quantity)?
15. Where do you usually sell them?
16. How long would it take you to sell 12 Cucurbits?
17. Is there any demand for Cucurbits? Yes No
18. If yes, where or by whom
19. How do you keep your Cucurbits when they are in plenty?
20. Where did you get the seeds for the two previous seasons?
21. How do you care for the seeds from the time you get them from the fruit until planting?
22. If Cucurbit seeds were to be available in your local shop as modern vegetable seed, would you buy them?
23. Are there any traditional beliefs associated with the use of Cucurbit plants? Yes/No
24. If yes, please give details
25. Do you know any medicinal use of these Cucurbits plants?
- | | | |
|-------------|-----|----|
| For people | Yes | No |
| For animals | Yes | No |
26. If yes in any of the above, give details
- | | | |
|-------------|-----|----|
| For people | Yes | No |
| For animals | Yes | No |
27. Which of these Cucurbits do you advise us to grow and why? List them according to your preference

Appendix 3: Interview framework used during interviews with small-scale farmers at Guquka, Lower Gqumahashe and Roxeni

Questions on knowledge of the project

- ◀ Prior knowledge of the particular vegetables: Are they familiar with the three vegetables Amaranthus, Cucurbits and Plectharanthus?
- ◀ Which of the 3 vegetables are they planting?

Questions on their relationship with project/project leader

- ◀ Where did they receive the seed from?
- ◀ How were they assisted and by whom with regard to the planting of the seeds and the harvesting of the produce?
- ◀ How many seasons have they planted these seeds already?

Questions on practical implementation issues

- ◀ What vegetables are they planting in their vegetable gardens
- ◀ What kind of problems did they experience with regard to the planting, attending to, harvesting and drying of the seeds of the indigenous vegetables?
- ◀ What is their perspective on typical pests attacking the vegetables?
- ◀ What is their perspective on drought resistant faculties of the vegetables?
- ◀ How do they treat the soil (fertilizer, manure, compost, etc.)

Questions on effect of the project on the wider community

- ◀ How did the neighbours respond to the "new" crops?
- ◀ Did they sell some of the vegetables to neighbours?
- ◀ What variety is sold most?

Questions on their personal use

- ◀ How did they prepare the vegetable for eating?
- ◀ What was the response of the family to the "new" vegetable in taste, and so on?
- ◀ Did they experience any particular effect after having used the indigenous vegetables (impact on the prevention of particular illnesses, popular beliefs etc.)?

Questions on the continuation of farming with the indigenous vegetables

- ◀ How did they dry the seeds?
 - ◀ How did they store the seeds for the following season?
 - ◀ Are they going to plant the seeds again?
 - ◀ Are they extending the area to be planted with seed of the indigenous vegetables?
-

CASE STUDY 9

THE LANGEBAAN COMMUNITY-BASED GROWTH-MONITORING MODEL

Research for community utilisation

An intervention guided by Ms Serina Schoeman of the Nutrition Intervention Research Unit, Medical Research Council

by Maryke Hunter-Hüsselmann



View of Langebaan from the lagoon, photograph courtesy of <http://www.gpsa.co.za/>

CONTENTS

Abbreviations	399
Glossary of medical terms	400
1 Introduction	401
2 Organisational context: The Medical Research Council	401
2.1 The vision and goals of the MRC	401
2.2 Integrated Nutritional Programme as part of Government's National Programmes	402
2.3 The Nutrition Intervention Research Unit (NIRU)	402
3 The Langebaan Community-based Growth-monitoring Model	403
3.1 Background to the project	403
3.2 The community of Langebaan	403
3.3 Need for and initiation of the project	404
3.4 Aim, objectives and methodology	404
3.5 Key role-players and their responsibilities	406
3.6 Research processes	407
3.7 Successes and outcomes of the project	412
4 Mode of knowledge production	412
4.1 The nature of the research process	412
4.2 Factors that impacted negatively on the research process	417
5 Knowledge transfer and utilisation in a community	418
5.1 Matching research goals with community needs	418
5.2 Building capacity in the community	419
5.3 Shifting responsibilities	420
6 Lessons learnt from this case and concluding comments	424
Data sources	427
Face-to-face interviews	427
E-mail responses to additional questions	427
Questionnaire	427
Publications and documents	427
Other	427

Abbreviations

CBGM	Community-based Growth-monitoring
INP	Integrated Nutrition Programme
NGO	Non-governmental organisation
NIRU	Nutrition Intervention Research Unit
MRC	Medical Research Council
TB	Tuberculosis

Glossary of medical terms

- ◀ Anthropometry
The measurements of body size, weight, and proportions, which can be sensitive indicators of health, development and growth in infants and children.
 - ◀ Amoebiasis
Infection with any of various amoebae. It is an asymptomatic carrier state in most individuals, but diseases ranging from chronic, mild diarrhoea to fulminant dysentery may occur.
 - ◀ Deworming
Refers to the treatment of children with or prevention of worm infections.
 - ◀ Diarrhoeal episodes
The number of times a person reported as suffering from diarrhoea within a given period.
 - ◀ Growth-monitoring
Periodic assessment of child growth, or regular measurement of weight (and sometimes length) that will lead to the detection of changes in the child's physical development.
 - ◀ Growth-faltering
A drop in weight or failure to gain weight over two consecutive months in accordance with the reference of birth curve on the road-to-health card.
 - ◀ Intestinal parasites
A parasite is an organism obtained in food and shelter from another organism. When it is located within the lumen of the intestine it is referred to as intestinal parasites.
 - ◀ Immunisation coverage
Completion of childhood immunisation at a specific age within a scheduled time frame.
 - ◀ Mebedazole
A substance containing Methyl-5-benzoyl-2-benzimidazolecarbamate. A nematocide in humans and animals. It acts by interfering with the carbohydrate metabolism and associated energy production of the parasite.
 - ◀ Trichuriasis
An infection of the large intestine by *Trichuris trichiura*. It may be the most common helminthic infection found in Americans returning from subtropical and tropical areas. Children have the highest rate of infection due to a general lack of sanitary habits. Treatment is with mebedazole.
-

1 Introduction

Growth-monitoring is a key activity in nutrition promotion programmes in the battle against malnutrition. National studies done in 1994 and 1999 have shown an underweight prevalence rate of 10% for South African children (Schoeman, 2004:2).

In 1994, the Nutritional Intervention Research Unit (NIRU), a research unit of the Medical Research Council (MRC), was approached by the Child Welfare Society of South Africa to perform an investigation on perceived problems of malnutrition in the West Coast area. After negotiations with all relevant role players, it was decided to implement a community-based growth-monitoring model in Langebaan North. The negotiations, which started in 1994, were followed by a baseline survey conducted in October 1995. The model, was implemented after the baseline survey and the ZOPP workshop. The project ran from August 1996 to March 1998 and were successful in determining the effectiveness of such a model in helping existing health facility services in a community.

In September 2003, contact was made with Ms Serina Schoeman, the project leader of the Langebaan study. She provided the relevant background documentation to the project and agreed to a formal interview. A focus group interview was also conducted with women volunteers from the Langebaan North community, who were trained to do the monitoring for the research project.

This case study aims to provide insight into the research processes implemented in the project and to determine the extent to which knowledge production and utilisation strategies were effectively transferred to the community – thereby ensuring sustainability of the project within the community.

2 Organisational context: The Medical Research Council

2.1 The vision and goals of the MRC

The Medical Research Council was established in 1969 with the main research objective of improving the nation's health status and quality of life through relevant research aimed at promoting equity and development. According to the MRC, its values are a culture of human rights, transdisciplinarity in research and being a learning and sustainable organisation. It is an autonomous body, but reports to the national Department of Health (<http://www.mrc.ac.za/>). It receives 60% of its budget from the Government Science Vote. It seems that the MRC has in undergone major transformation in recent years:

It is increasingly 'Africanised' in terms of its research and organisational philosophy, its gender and ethnic profile, and its collaboration with other African countries. It is also increasingly internationalised through collaboration with most of the world's leading health research agencies, including the National Institutes of Health and Centres for Disease Control and Prevention in the US, the Gates Foundation, the World Health Organisation, the Wellcome Trust, the Pasteur Institute, the KEMRI in Kenya and the Blair Institute in Zimbabwe. (www.gov.za/yearbook/2001/science.html)

2.2 Integrated Nutritional Programme as part of Government's National Programmes

The MRC works with the national and provincial departments of health to ensure that its research findings feed into policy formulation and health-care practice. Its research activities are directly aligned to the health priorities of the nation and are grouped in six national programmes:

- ◁ National programme for research in molecules to disease
- ◁ National programme for health systems and policy research
- ◁ National programme for infection and immunity research
- ◁ National programme for non-communicable disease research
- ◁ National programme for environment and development research, and
- ◁ National programme for women and child health research.

These focus areas were identified by the South African government as high-priority in keeping with international trends and provides the basis for the MRC's resource allocation. Within each focus area, the MRC has several units and Lead Programmes in the areas of Telemedicine, Crime, Violence and Injury, TB and Malaria. The Integrated Nutrition Programme (INP) was developed as a recommendation of the Nutrition Committee appointed in 1994 by the Minister of Health to develop a nutrition strategy for South Africa. Before the establishment of the programme, the approach to nutrition was a fragmented food-based one and the goal of the INP was to develop an integrated approach.

The SA Bill of Rights describes sound nutrition as a basic human right and it is perceived as more than just the availability of food or the consumption of a certain amount of nutrients per day. The INP therefore is part of a primary health care approach that tries to explain malnutrition as "... the outcome of interrelated, complex basic, underlying and immediate causes and nutrition programming as an ongoing process of assessment, analysis and action" (<http://www.doh.gov.za/programmes/nutrition.html>).

2.3 The Nutrition Intervention Research Unit (NIRU)

Nutrition research within the MRC is directed by a number of factors, and one of the most important is the requirements of the macro-environment.

The macro-environment of the MRC represents governmental ministries, international organisations, NGOs, bilateral agencies, academic institutions and the private sector – the latter having signalled the direction and focus for nutrition research in South Africa. (www.mrc.ac.za/nutrition/about.html)

The Nutrition Intervention Research Unit falls within the national programme for women and child research and actively complies with national and international priorities related to nutrition. Its research agenda addresses the most pressing nutritional imbalances in South Africa.

Under-nutrition not only affects the growth and development of children, but it may also contribute to ill health and functional impairment in every stage of the life cycle. (www.mrc.ac.za/nutrition.about.html)

The NIRU operates within the framework of the MRC Corporate Strategic Plan and contributes to:

- ◀ Nutrition knowledge and innovation through peer-reviewed publications
- ◀ Policy formulation and implementation through participation in advisory panels
- ◀ Capacity development through courses, presentations and involvement in postgraduate studies
- ◀ Technology transfer through development of nutrition software, and
- ◀ Income generation through a variety of approaches.

3 The Langebaan Community-based Growth-monitoring Model

3.1 Background to the project

Community-based nutrition surveillance studies are one of the NIRU research highlights. This type of research addresses one of the main concerns stated in the Integrated Nutrition programme of Government. It is directed at aiming to improve the nutritional status of children by involving the community. This research aims to inform caregivers of infants and young children of correct practices in lowering malnutrition. It also strives to improve general knowledge around health and the well-being of the infant and child. One form of nutrition surveillance is through growth-monitoring.

Growth-monitoring and promotion is one of the most useful tools available in infant and young child health because it provides quick and easy information to detect disease early and to monitor the nutrition status of the child. (www.doh.gov.za/programmes/nutrition.html)

By involving the community, it directly addresses undesirable dietary habits and nutrition-related practices, attitudes, perceptions and social-cultural influences that could adversely affect nutritional status. The focus of this case study is the Langebaan Community-based Growth-monitoring Model. The specific community targeted for the project influenced the dynamics of the project. Therefore, a demographic profile of the community of Langebaan is provided.

3.2 The community of Langebaan

Langebaan is a small urban town on the west coast of the Western Cape, South Africa, approximately 136km from Cape Town. It has a population of approximately 4 000 people, and a preschool population of ± 350 children. The town is a typical fishing community. Most of Langebaan North's inhabitants earn their living from fishing and have a low income. Langebaan is also a big tourist attraction and a small group in Langebaan generates income with holiday homes or guesthouses.

3.3 Need for and initiation of the project

The Child Welfare Society approached the National Research Programme for Nutritional Intervention of the Medical Research Council in January 1994 to investigate perceived problems of malnutrition on the West Coast of South Africa.

A nutritional status survey was done at crèches in Vredenburg, Paternoster and Langebaan as part of the investigation. The prevalence of malnutrition among crèche children was not serious and it was decided to do a community nutritional status survey. Langebaan was selected as an ideal town to research the extent of the problem because it has a manageable population size and is nearer to the MRC.

The investigation showed that the town had a low birth weight prevalence rate of 22%, while 7% of the preschool children were underweight. Some of the problems that were identified at the health facility practice included: sporadic clinic attendance of preschool children and poor growth-monitoring after 12 months old; poor nutrition and health promotion practices; and limited physical and financial resources. This resulted in:

- ◀ Poor growth-monitoring practices and poor promotion of growth-monitoring;
- ◀ Sporadic targeting of nutritionally at-risk or malnourished children;
- ◀ Inability to address the problem of malnutrition successfully through the health facility, and
- ◀ Generation of data that is not sufficient for health or nutrition surveillance.

The Community-based Growth-monitoring model that was established in Langebaan, *demonstrated a simple, practical and cost-effective way to complement existing health care services in addressing these shortcomings and was seen as complementary to the existing health facility practice, thereby serving to strengthen the preventive arm of health care. (Serina Schoeman, interview, October 2003)*

3.4 Aim, objectives and methodology

The Langebaan project's aim was to develop and test a growth-monitoring model within a community by directly involving the community in the whole process. This was determined by a baseline survey on nutritional status assessment that included anthropometry, nutrition and disease profiles, and worm infection prevalence. The idea was to transfer the project successfully to the local clinic, thereby extending the capacity of the health facility in monitoring growth and nutritional status of the preschool children in the community. Linked to this was the creation of jobs for unemployed women in the community who received training in anthropometry and growth-monitoring. The training equipped them with skills and knowledge to monitor nutritional status, and to identify and refer those children who need nutritional support to the health facility.

The development and implementation of the growth-monitoring model was the focus of the project, but the researchers also wanted to determine the prevalence of infections from intestinal parasites in the community as it can compromise nutrition in various ways (Intervention Protocol, May 1996). An interview with Ms Schoeman implied that the focus was on growth-monitoring and that the deworming focus was introduced after the

completion of the baseline study for the Langebaan project. However, it seemed to have progressed into two sub-projects each with its own aims, objectives and very different impacts on the community.

The discussion, therefore focuses on these two aspects of the project as two sub-projects i.e. growth-monitoring and deworming. The two sub-projects had separate intervention protocols and in the next sections, are discussed separately in terms of its specific aims and objectives.

Aims of the community based growth-monitoring model

The aims of the community-based growth-monitoring model include:

- ◀ Assessing nutritional status and all factors that may influence nutritional status in children 0-6 years;
- ◀ developing and establishing a community-based nutritional status monitoring programme that also include nutrition and health promotion and nutrition surveillance, and
- ◀ Monitoring and evaluating this programme as a model for future application in other communities.

A crucial component of the entire process was community participation, which would be obtained through the following:

- ◀ Consultation with the community and relevant role players including the education and health sectors;
- ◀ Capacity building in the community to enable them to execute certain procedures accurately and safely for a baseline study, and
- ◀ Training of community representatives to do a situational analysis based on information collected during a baseline study.
- ◀ A situational analysis in collaboration with community representatives based on information collected during the baseline study and the ZOPP workshop.

Specific objectives of the community based growth-monitoring model

The growth-monitoring model was executed in four phases with specific objectives for each phase.

Phase I – Assessment: The objective was to test the community's attitude and support for the study by having meetings and discussions with community leaders, local organisations and health providers. The community had to identify suitable community representatives to receive training as nutritional status monitors. They would also be trained in interviewing skills.

Further objectives were:

- ◀ To determine the nutritional status of children 0-6 years,
- ◀ To determine the knowledge, attitudes, practices and beliefs of the community towards health nutrition,

- ◀ To determine the prevalence of parasitic infections, and
- ◀ To determine the health status of children regarding immunisation coverage, diarrhoeal episodes, clinic attendance and growth faltering.

Phase 2 – Analysis and planning: The data of Phase 1 would be analysed in this phase. An “objective-oriented-programme-planning workshop” (Intervention Protocol, July 1995) would be held with community representatives to discuss the results of Phase 1 and on the basis of that, develop a growth-monitoring model and plan of action.

Phase 3 – Preparation and implementation: In this phase the objective was to prepare and test the model for the use of growth promotion and nutrition education at specific meetings; to train and prepare voluntary workers at these meetings; to implement the model, and to monitor and to do continued training and problem solving with the voluntary workers through regular meetings.

Phase 4 – Monitoring and evaluation: The objective of the last phase was to do continuous monitoring of the programme by focussing on programme delivery and coverage and to complete an evaluation of the programme.

Aims and specific objectives of the deworming project

It became clear from the baseline survey completed in October 1995 for the growth-monitoring model, that the worm infection rate was more than 70% for children. The main aim of the sub-project was therefore to implement an effective, community-based treatment of worm-infection to significantly reduce infection prevalence, growth stunting and underweight. A secondary aim was to define the significance of amoebiasis in the community.

The specific objectives of the deworming project included:

- ◀ To treat all preschool children at intervals of four months for at least two years with 500mg stat doses of mebendazole
- ◀ To treat all primary school children at the same schedule with 500mg stat doses of generic mebendazole
- ◀ To monitor the prevalence of worms by obtaining stool samples prior and after the respective treatments
- ◀ To train local people with the implementation of treatments and to complement community health services

3.5 Key role-players and their responsibilities

Some role-players were directly involved as volunteers or researchers, while others were more indirectly involved (i.e. not on-site involvement) through financial assistance or providing essential medicine or research equipment.

The following role-players were actively involved in the project:

- ◀ MRC Nutrition Intervention Research Unit guided the research and implemented the growth-monitoring model and deworming model at Langebaan.
- ◀ Janssen-Cilag sponsored Vermox deworming tablets during the research period and provided literature, pamphlets, posters and several items that raised community awareness. They also promised to provide the Vermox at wholesale price when the project was transferred to the community.
- ◀ The Langebaan community actively took part in the research – women of the community participated by bringing their children to strategic points in the community for growth-monitoring and deworming. The St James Anglican Church, crèches, rooms at the school, the clinic and even a private home were provided to facilitate research activities.
- ◀ Community volunteers were trained to do the anthropometric measurements, growth-monitoring and distribution of the deworming pills. These nominees were also used to organise and establish health points within the community for the growth-monitoring activities.
- ◀ The local health facility provided their assistance and venue during the monitoring periods. A room at the health facility was allocated as one of several points in the community where children's growth was monitored. The nursing sister in charge of the local health centre was involved from the first discussions with the community. She also allocated a room at the health facility that were used as one of several points in the community for monitoring of children's growth, and another room was used as a laboratory for children's stool analysis.
- ◀ The municipality of Langebaan actively supported the MRC researchers in various ways i.e. assisted in planning, motivation and accommodation and actively took over the responsibilities for sustaining the programme in the community after 1998.
- ◀ Department of Health provided access to records for registration, and to ensure adequate preschool coverage for the deworming project. They also gave input in the development of the research process and implementation of the programme in Langebaan.
- ◀ Department of Education took part in the training of local women during the ZOPP workshop and gave input in the development of the research process and implementation of the programme in Langebaan. They also accepted responsibility for the six-monthly deworming of pupils at Langebaan Primary.
- ◀ A specialist consultant on worm infections and a technologist from the Amoebiasis Programme at the MRC was responsible for monitoring and analysing the status of the deworming project.
- ◀ Sanlam, Anglo-American and De Beers Chairman Fund provided financial support during the initial and follow-up phases of the programme.

3.6 Research processes

NIRU researchers, in conjunction with the Child Welfare Society did a nutritional status survey in Vredenburg, Paternoster and Langebaan after the Child Welfare contacted

the MRC in January 1994 to investigate the perceived problems of abuse and malnutrition on the West Coast. These studies were done at crèches in the area and ran from September 1994 to October 1994.

Feedback on these studies were provided in January 1995 and Phase 1 commenced in February 1995 after the decision to base the growth-monitoring model in Langebaan. The MRC approached the health department, local Municipality, health and women committees as well as community representatives to discuss and obtain their permission to do research in Langebaan and to conduct an initial baseline survey in Langebaan. It was decided to involve local women to assist with the survey that was conducted from September 1995 to November 1995. Eleven women from the community were trained in anthropometry, growth-monitoring and to administer the questionnaires for the baseline survey. The training consisted mainly of practical demonstrations by professional medical practitioners and researchers.

Phase 2 started in December 1995 when the survey data was analysed. A ZOPP workshop was facilitated in June 1996 by NIRU to give feedback to the community and different stakeholders on the survey results. The participants were given the opportunity to participate in the planning and implementation of the growth-monitoring model.

This process stimulates collective thinking and discussion of problems and allowed participants and researchers an equal opportunity to contribute to the determination of priority needs. It increases community awareness, clears wrong perceptions, facilitates equal representation of the community on community forums, promotes participation and eliminates suspicions, thus creating a non-threatening relationship between consumers and providers of health care. (Schoeman et al, 2000:2)

The workshop participants included stakeholders from the Departments of Health and Education, the local Municipality, non-governmental organisations, health and women's committees, representatives of the community and NIRU staff.

At the workshop, stakeholders agreed that a CBGM model could address needs related to nutrition, which the local health facility practice could not accommodate. The women, originally trained to do anthropometry and growth-monitoring for the baseline community survey, volunteered to manage the CBGM model. Growth-monitoring points were established in consultation with the church, school, crèches, municipality, and individual homes in the community. An appointment system was suggested to accommodate mothers in geographical areas nearest to the growth-monitoring points to ensure effective functioning of the model.

In July 1996, the volunteers received refreshment courses in anthropometry, growth-monitoring and mass deworming and in August 1996, the growth-monitoring and deworming programme commenced (phase 3). Information on growth-monitoring was collected every four months and the women volunteers in the community used a simplified growth chart for documentation, plotting and interpretation.

The deworming project started with 72% of school children affected by whipworm, which responds slowly to treatment. It was therefore essential to have a programme of repeated treatments for up to three to four years to check results. It was even more important that the number of worm eggs in stools had to be reduced drastically because it contaminates the environment and is the source of infection and re-infection. In Langebaan, deworming medication in the form of a pill provided by Janssen-Cilag was given to children every four months and before each successive dose, stools from all the children were examined microscopically for worm eggs. These pills were given to the children under the supervision of a MRC worker or community volunteer and at first; the local clinic was used as a base for operations.

The growth-monitoring and deworming projects ran for approximately two years in Langebaan with close monitoring and supervision from personnel of the MRC. In March 1998 however, the MRC started negotiations with the community and leaders in the community in order for the MRC to withdraw and the continuation of the project by the community (phase 4). Worm infection rate at that stage had dropped to under 30% and the length and weight of children were regulated. The MRC decided that because of this improvement, deworming treatment only needed to occur twice a year – in March and in September.

It was also decided that because it was difficult for working mothers to bring their children to the local health facility for treatment, that medication should be given by teachers at schools. During a workshop with the teachers in August 1998, the teachers took responsibility for the distribution of deworming tablets to schoolchildren. Parents were encouraged to regularly take their children for growth-monitoring although the facilitation and monitoring would be done by the community volunteers independently. However, the community was ensured that MRC personnel would still be available for any questions or problems that might occur. Ms Rhona Ocks from the community was appointed as a co-ordinator of these programmes.

In February 1999, the Municipality of Langebaan informed the MRC that they were willing to take steps to implement the continuation of the deworming programme for the children in Langebaan (preschool and primary school). It was negotiated that Ms Ocks stay on as co-ordinator as the MRC was contractually required to pay her basic salary until August 1999. It agreed that the clinic sister would supervise the women with the pre-school component. They also provided a computer for the local health facility to help Ms Ocks with her administrative duties. The municipality agreed to accept the main costs relating to the deworming and growth-monitoring of the children:

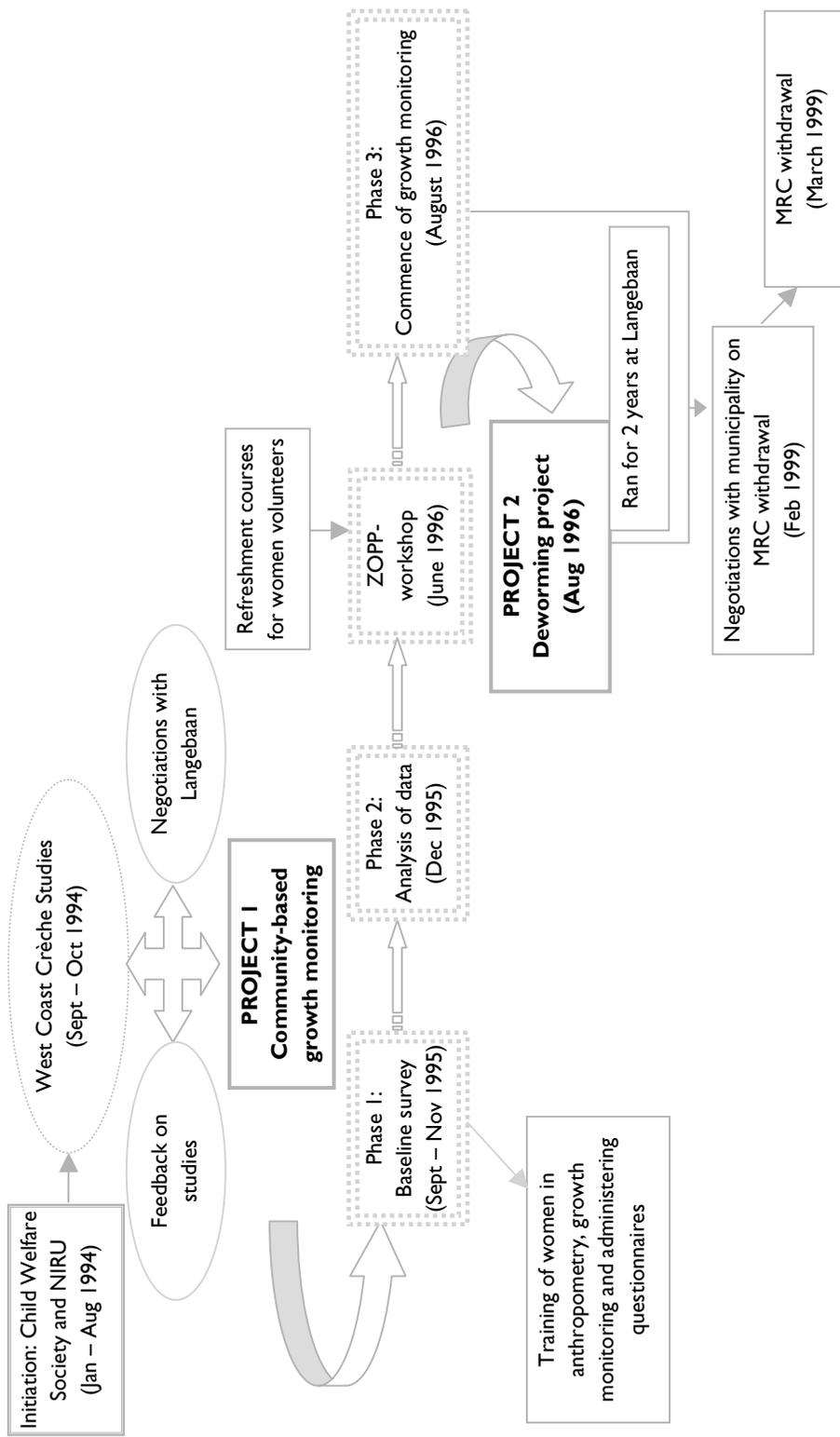
- ◀ The salary of Ms Rhona Ocks from August 1999
- ◀ Services rendered payments to the community health workers
- ◀ Deworming medication (Vermox 500mg tablets) to be purchased at wholesale prices as agreed upon by Janssen-Cilag Pharmaceuticals, and
- ◀ Towards the end of 1999, the cost of test stools from about 70 children to make sure deworming was effective.

At that time, the mayor of Langebaan, Mr Malherbe was very excited about taking over the programme and in March 1999, he ordered the first batch of Vermox tablets and requested some guidance as to how to implement the programme effectively in the community. The MRC offered assistance in this for the first round, after which the community had to operate independently with assistance from the NIRU if needed.

In accepting the responsibility on behalf of the Langebaan community, mayor Willem Malherbe said in a local newspaper:

The empowerment of local people to do a job that ultimately benefits our children and therefore our community, is something to be proud of. We are fully geared up to follow in the excellent footsteps that the MRC left behind with the understanding that the MRC will provide advice where needed.

Figure 2: Flowchart of the Langebaan community-based growth-monitoring project



3.7 Successes and outcomes of the project

The growth-monitoring model was successfully implemented in Langebaan. There was increased coverage of pre-school and primary school children for health and nutritional promotion. Children were regularly monitored and their nutritional status improved dramatically. After August 1996, the worm infection rate dropped from 72% to 26%. The model therefore effectively complemented the existing health care services in the community.

Other specific outcomes included:

- ◁ Strengthening community skills in assisting with nutrition and health promotion activities
- ◁ Fostering community participation across the health sector
- ◁ Involvement of women and teachers in various aspects of planning and provision of health services
- ◁ Establishing mechanisms to improve public accountability and promote dialogue and feedback between service providers and users through workshops / discussions etc.
- ◁ Encouraging communities to take greater responsibility for their own health
- ◁ Publication of an article and related research media reports, press releases, congress reports etc., and
- ◁ Job creation in the community.

4 Mode of knowledge production

4.1 The nature of the research process

Participation

The MRC started this research project with the explicit goal to do a community-based intervention. This implied a strong participatory approach whereby the community were actively part in the whole research process. The underlying assumption was that there would be benefits to both the researchers and the community. On the one hand, the MRC could develop and evaluate a growth-monitoring model in a community, and on the other, the community could actively be mobilised to improve comprehensive health care delivery in the community.

This process that requires community mobilisation to maximise community participation in planning and shaping of their environment, is necessary for social development and improving health care delivery. Increased community awareness is necessary to prompt self-care in order to reduce the recurrence of disease. This however can only be facilitated if communities are allowed to play a prominent role in preventive health care practices, and are informed about factors that precipitate disease. (Serina Schoeman, June 2000)

The sister from the local health facility seemed to have played a major role, not only as a first entry point to the community but also as a facilitator of action on the part of the community.

I think I must just elaborate on the role of the clinic because the sister played a very major role. By the time we started negotiations, she had already established various committees – there was a health committee that consisted of women in the community, there was a housing committee, welfare committees and all those were run by women of the community, so when we started to negotiate with the Langebaan community, our first entry point was the clinic sister and with our encounter with her, we involved all the various committee members. (Serina Schoeman, interview, October 2003)

Participation from the community really started in the beginning of the research process, but largely after the baseline survey was done. Although the community was not actively part in constructing the survey, discussions were held with key persons in the community to establish certain problem factors within the community.

No, (they were not involved in constructing the baseline survey) but they have guided us. With our meetings with the sister, she also told us what the main problems were – she was very concerned about malnutrition, social problems, children that were being neglected, alcoholism especially among the men, and unemployment. Those were the main problems. There were a lot of committees and a lot of other organisations involved in the workshop and according to me, we all were very open to the community. (Serina Schoeman, interview, October 2003)

I think we took the sister as the soundboard or the voice of the community because she had very good access to them and most of the things that she discussed with us were actually confirmed during the ZOPP workshop. (Serina Schoeman, interview, October 2003)

At the ZOPP workshop, it became clear that the community was very keen to get involved in the research process. They became aware of the fact that a professional body could address their problems, but according to Ms Schoeman, there was also a monetary motivation:

They were very keen to get involved but I think my experience with communities is that there is always a motivation behind this, and in this case, their motivation was besides the fact that they are a very caring community, they also had this problem of unemployment and this was a potential source of income for them. At the ZOPP workshop, 11 women from the community were recruited for this study and those women indicated that they would like to become involved and drive the process and although they started as volunteers, they were paid later. (Serina Schoeman, interview, October 2003)

Mostly women from the community were involved throughout the project. According to Ms Schoeman this is a normal trait in communities. However, the men were co-operative and positive about the project.

I think women are more caring and even before the ZOPP workshop one of the complaints of the sister, and this was also confirmed by the women, was that the men are very lazy. They did not want to get their hands dirty. None of the men were really involved in the monitoring model but they became very co-operative. If some of their wives were working, they would bring the child to the growth-monitoring centre and they would ask questions about growth-monitoring, so that was quite positive. (Serina Schoeman, interview, October 2003)

Awareness-building

The research process also facilitated awareness building in the community. In part, this could be one of the reasons why the men also became positive about the whole project. Although people from the community listed nutrition as one of the problems in the community, they were not aware of the extent of the problem and reasons for its existence. Through the research process, the community became more informed.

I must say nutrition as such – they were not surprised about that really because nutrition or malnutrition is a fairly relative term. Everybody uses it and say that they have problems with malnutrition but they are not aware that you can measure it in certain things. We measure it by means of weight and height. On calculating the weight, we looked at the underweight rate which comprise children whose weight fall below the 3rd percentile, or if we express it in Z-scores, it would comprise children with a Z-score below –2 standard deviation, but the public is not aware of that. They would not measure it in these terms, so unless the child was extremely underweight and it was visible, then would not notice that a child is malnourished. (Serina Schoeman, interview, October 2003)

Although the community stated nutrition as a problem, they were unaware of the problem of whipworm. Ms Schoeman stated that the reason for that was that infection by whipworm was also not visible. It can also lay dormant in your body and not really affect your physical well being from the start. Only at the ZOPP workshop, the community became fully aware of the problem. Many women were very upset because of the misperceptions about reasons for worm infections.

We invited all the stakeholders (to the ZOPP workshop) and there were also many people from the local newspaper. Some of the mothers were upset about certain articles on the worm infection. There was a bad association with worm infection in the community. If a child had a worm infection, there was a perception that the mother was not caring enough or doing something wrong. Initially the information about worm infection was a bit shocking to them but their perceptions of worm infections changed after the workshop. Initially they thought it occurred because they don't care but after we explained the whole cycle of worm infection to them, they had a better understanding of worm infection. (Serina Schoeman, interview, October 2003)

The volunteers that were interviewed during a focus group discussion agreed that in the beginning, they felt a bit concerned that if the news about the worms would spread, the idea would be that the public would perceive them as not looking after their children.

Yes, it was very bad. People felt uncomfortable because I don't want to know if my kid has worms, and that one doesn't want to know if his kid's got worms, but it was in the papers with the heading: "Langebaan kids infested with worms", and its was very bad because it looked as if we didn't look after our children properly. (Focus group, November 2003)

Communication

Effective communication and interaction between the community and the MRC was one of the essential components in establishing an intervention that could in the end be independently run by the community itself. In its efforts to establish communication channels with the community, the MRC realised that it had to actively keep the community involved and informed about the research process and development. Therefore, regular meetings between the researchers and the community were held. These meetings, mostly initiated by the MRC not only kept the community informed, but had the added effect of ensuring that the community stayed interested to give there assistance and co-operation with the project.

So the process that we actually worked through was that we would contact the municipality because they provided us with accommodation during our stay in Langebaan and of course we also invited them for every meeting that was arranged. And they also gave permission that the sister could attend. We also contacted the co-ordinator of the project in the community Ms Ocks, who would arrange for all the volunteers to be present and she also invited members of the community to attend. (Serina Schoeman, interview, October 2003)

After every 4 monthly growth-monitoring session, the women volunteers were also given feedback and were asked to recap on the positive and negative experiences they had. In the beginning, the women were somewhat reluctant to open up and speak their mind. Ms Schoeman indicated that a reason for this could be that the volunteers saw her as a person of power and knowledge and that they were not really in any position to give negative feedback.

So they were really allowed to speak their minds. Sometimes in the beginning, when they had negative experiences, they did not want to speak but I encouraged them to feel free to share what was on their mind. So actually, they were only reluctant to speak in the beginning, but I told them that if they remain silent, I would not know what is wrong. You know that is also part of the dynamics of a community. We come in and they see you as a person in a power position. And I really tried to break that down, but I don't really know to what extent a person achieves that. (Serina Schoeman, interview, October 2003)

Although some volunteers were reluctant to speak their mind in the beginning, it seems as if their interactions were perceived as mainly positive. After a few meetings, the project leader was able to establish trust with the women and then they became more open. On

asking Ms Schoeman if she was consciously aware not to use certain medical terminology, she explained that it was never a problem.

I think because I have worked with communities for so many years, I tried to express myself in a way that they could understand and if I don't get an answer, I would ask the question in a more elementary way and I would also listen to how they describe certain things and try to use their language. (Serina Schoeman, interview, October 2003)

Effective and ongoing communication, especially with the women volunteers was essential in ensuring that the standards and quality of the research process was maintained. It was necessary that the women understood exactly what they had to do and how the monitoring should be done in order to limit mistakes that could in the end jeopardise the research results.

Quality control

Training in growth-monitoring and ongoing refreshment courses played a huge role in ensuring that the volunteers knew how to complete a questionnaire (for the baseline study) and monitoring sheets and how to detect possible related health issues in the community. However, the process was continuously monitored through regular spot checks. A MRC staff member was on the premises during the four-monthly growth-monitoring to deal with problems and to make sure that it was done properly.

What we did is that after they had completed the questionnaires, we would perhaps select every 5th or 10th questionnaire to do spot checks to see if it was completed properly. We did the same with the anthropometry. Every 10th child's growth chart were checked to see if it was completed properly. I had to spend some time to explain how they had to complete the charts. But we also made provision for mistakes. They had to record number in blocks. If they did not have a good idea how to record the height and weight in the blocks, there where space on the sheet where they could just write the weight or height as is. Another thing we did was we used two women to do one child's anthropometry – the one would weigh the child and read the weight out loudly, while the other person would write it down and then they would just check it again to see if it is correct. The other thing was during the follow-up monitoring session after 4 months, they were instructed to check for big differences between the previous and the current weight. (Serina Schoeman, interview, October 2003)

The project was successful in its ability to facilitate community participation, and to communicate all relevant aspects of the project and its development to key role players. An awareness of the problem of growth and deworming was established in the community. Quality control was ensured by the constant presence of a MRC staff member even though women of the community were administering the growth-monitoring charts and doing the actual monitoring. The visibility of the MRC in the community gave the women the opportunity to voice their concerns on a continuous basis and to ask for help if needed. In the next section, factors that negatively impacted on the research process are discussed.

4.2 Factors that impacted negatively on the research process

The MRC made sure that effective communication channels were established to inform the community about the research project and what it would entail. Initially however, some role players in the community were reluctant to get involved and give their support. A reluctant role player was the school, through the principal, as they would have to distribute the deworming tablets and perform weight monitoring of school children, initially implemented by the volunteers.

I think it was just a type of lethargy that you find at certain schools. There is just no interest and of course that is largely determined by the principal. He was an elderly man – he retired since – he was not interested in all of this and because he was not interested, I think he might not have communicated it to the staff. This is something that we picked up. So, in this regard, we had a problem of poor communication with the school – we just could not get through to them and you know after a few meetings, I decided to go and have a word with the principal and I also listened to what the teachers had to say and whenever we got there, some of the teachers would say that they were not aware of the meetings or they would ask why we did not inform them about it. So I spoke to the principal and asked him if it was a problem for him to get the cooperation of the teachers. So in the end, you know, in small communities whatever you do, everyone knows about it, so I tried not to exclude anybody – I talked to him about the problem and asked him for suggestions as to how we can solve it, and in this way, the responsibility was placed on him! (Serina Schoeman, interview, October 2003)

The Department of Health's reluctance to attend the workshops and meetings that were held in the community also posed a problem. Involvement from top management was vital to keep the DOH informed about the growth-monitoring model and its successes. Ms Schoeman explained that because the model was based on a more preventative approach to health and the Department had a history of focussing more on curative health approaches, they did not see the establishment of a model as high priority.

I think maybe they had other priorities but maybe they did not regard this as equally important as other health aspects. Because again this model is more preventative in nature. If you talk about growth-monitoring and you compare it with something like TB, you know, it is just not comparable. Although it is also important. And I think this was the attitude of the health personnel or the top structure. (Serina Schoeman, interview, October 2003)

The national goals of the DOH also incorporated an active shift to a greater focus on preventative practice during the last few years and therefore this reluctance was surprising to Ms Schoeman. She saw the development of this model as equally important to inform national goals in the establishment of a national growth-monitoring system that could be used in communities to assist the health facilities in their practices as there was no good growth-monitoring system in place.

It is a problem from the top and it is a problem with preventative health care (in this country). This is an overall problem and a major one. Unless the people from the top level decide that prevention is equally important,

*models like these will not be accepted and neither make a difference.
(Serina Schoeman, interview, October 2003)*

The lack of motivation was another problem. At first everyone was keen to assist in the project, but as it progressed some became demotivated and monetary incentives became more important.

Firstly the women volunteers - initially they were very motivated and initially all the workers had this romantic idea of getting involved and later on I think monetary incentives became more important. This was the case with some of the workers. Some of them became a bit slack and the problem was instead of trying to target the women to bring their children for growth-monitoring within a certain time period, they would prolong it. With some of the community leaders we also had problems. One was the pastor of the Anglican Church. You know at the beginning he was very keen in accommodating us in the church to do the monitoring and later on they also wanted monetary incentives. (Serina Schoeman, interview, October 2003)

As mentioned, the sister of the local clinic was very involved in the research process and was the driving force behind it in the community. However, the sister was transferred while the growth-monitoring was still being implemented. The new sister saw the process as a threat to her authority. The women volunteers were doing growth-monitoring in the clinic and this implied them “working in her space” (Serina Schoeman, interview, October 2003). These women had no formal training in nursing and because the project were seen as very positive in the community and had visible effects on the health of the children, it was seen as jeopardising her standing in the community.

*The second one saw it as a threat. The women actually took over the growth-monitoring at the clinic and she would just withdraw and leave the monitors all on their own so it was a bit threatening for the new sister.
(Serina Schoeman, interview, October 2003)*

Although these minor problems could be resolved while the MRC was still actively involved in the community, the challenge came after the MRC decided to transfer the model to the community. The next section deals with knowledge transfer and utilisation processes that took place in the community and the effect of the MRC's withdrawal.

5 Knowledge transfer and utilisation in a community

5.1 Matching research goals with community needs

Ms Schoeman made it very clear that the MRC was not a service provider. The focus of this project was to implement a community-based growth-monitoring model, but the main aim was to do research. NIRU's main goal was to investigate whether a model could be established to assist local health facilities in their practices and community members recruited to do the actual monitoring. However, it was clear from discussions with the different role players in the community, that the MRC was seen as a channel through which to voice concerns – not only health related but also social. Problems such as alcoholism, abuse and unemployment were some of the many related issues that people thought the MRC could address and help them with.

The MRC therefore had an added social responsibility – to provide the community with the necessary skills to address these related issues effectively.

During this ZOPP workshop where we presented the outcomes [of the baseline survey], we also looked at what we could do as a nutrition intervention research unit [to address concerns about social problems] – we put it on the table for them and they were told to approach available resources to assist them with the problems that were beyond our scope – so the decision was left in their hands. We were very open to the community. (Serina Schoeman, interview, October 2003)

Although NIRU could not address these social issues themselves, they provided the women volunteers with the necessary skills and training to do so. Besides training in anthropometry, the women were also guided on how to deal with child abuse, issues of alcohol misuse, should they be confronted with these problems, and later, computer training etc. The confidentiality aspect was emphasised. They were encouraged not to probe, and instructed to report any of these problems to professionals at the clinic for further management. This knowledge transfer process empowered the women of the community to actively deal with issues they previously did not know how to address.

The local sister established a women's committee in the community that met on a regular basis to discuss social problems. This mobilised them and provided the opportunity for members of the community to work together as a group. They could actively utilise the knowledge they received to improve not only the health condition of children in their community, but also related social issues of concern.

5.2 Building capacity in the community

The Langebaan project built the capacity of the community to participate and work together with a more formal institution to improve the health status of their children. Although not everyone was as directly involved in the project as the women volunteers, the whole community benefited by receiving regular updates on the project through the local newspaper and through their interactions with the monitors. The knowledge they received also built their capacity to realise what the causes of malnutrition and worm infection were and what strategies they could apply to improve it.

We learned a lot about food – about how fruit must be weighed and bread and so – it was very interesting. We learned a lot – we thought the bread caused the worms! They showed us pictures of other towns – like KwaZulu-Natal and their worm count was much lower than ours. But it's so windy here and the eggs get blown around and then the sand and the dogs. Yes, the community saw how it was working. If your child got that pill then everything got better. Like they explained to us – using videos and the stuff that we saw – that was very interesting. You can't believe that worms can do that to a person! (Focus group interview, November 2003 (translated from Afrikaans))

Evidently the women volunteers were proud of their involvement in the Langebaan project. They saw themselves as health workers in the community and were respected by the community for their involvement. Their self-esteem improved as a result and they were able to realise that they could also improve their own well-being.

You know we developed as people. It helps you a lot – you feel that you can do something and that you can help and make a difference in the community. (Focus group interview, November 2003 (translated from Afrikaans))

The community benefited from the MRC's presence and although it seemed that they were positive that the process of growth-monitoring and deworming could be sustained as an ongoing process, this changed after the MRC's withdrawal from the community.

5.3 Shifting responsibilities

In March 1998, the MRC started with its negotiations with community leaders to continue the project after their withdrawal. According to the MRC, their research had reached its main goals – it was proven that a community-based growth-monitoring model could be established and implemented and that it had successes in terms of assisting the local health facility in regularly monitoring the health status of children. Furthermore the worm infection rate of children had decreased dramatically. According to the MRC their research was completed and it was time to transfer the responsibility of the process to the community.

The MRC had done its best to ensure that the community could utilise what they have learnt independently. Throughout the process, they had regular meetings and interactions with community members, the women volunteers who did the monitoring were trained and received regular feedback. They were sure that the model was successful and they had the full support and commitment from the Langebaan community. It seemed from the documentation received from Ms Schoeman, that it was the Municipality of Langebaan who took the first step in deciding to take over the responsibilities of the project.

In February 1999, the MRC wrote a letter to the mayor of Langebaan at that time, Mr Willem Malherbe. They had heard from Ms Rhona Ocks, the co-ordinator of the project in the community, that the Municipality was taking steps to implement the continuation of the project. In the letter it was explained to him what the project would entail and what infrastructure was already put in place in the community. A launch for the take-over was organised and in March 1999, the Municipality had the sole responsibility of running the project in Langebaan.

It is clear from supporting documentation and interviews that apart from the letter to the mayor and informal discussions with the community, no formal workshop was held to inform all the relevant role players on what should be done in order to run the project on their own.

¹The mode of knowledge dissemination can be seen as informal and no formal structures were put in place to ensure the institutionalisation of the monitoring model in the community.

We sent letters to the community and to the municipality that we won't be able to stay there forever and then we suggested that they either take it over or we must decide or work out a plan of what is going to happen. There were no formalized signed contracts but the transfer was based on specific guidelines proposed by us. This was confirmed verbally during a taking over ceremony in Langebaan that was attended by the key role players, representatives of the community, municipality and so on. (Serina Schoeman, interview, October 2003)

What seemed to be a success story, however ended in the total disintegration of the project 2 years after the MRC left the community in 1999. Ms Schoeman explained why she thought the project gradually disintegrated:

There is nothing going on at the moment. But the people (volunteers) are still enthusiastic – we were there in May this year (2003) for a workshop and they said that they would still like to do the job but it seemed as if they were not needed anymore. I think this is part of the dynamics again of communities. They started off as volunteers and we gave them an incentive. But now, I don't think they will start on their own now because they are not getting any money and motivation. Maybe if somebody could motivate them. Nobody is doing growth-monitoring now because even if they do, what do they do with the information? If the sister is not interested in the information and it cannot be sent to us because we are no longer part of the process, what can they do? So this is the reason why it stopped. There was no further support from the health facility or even from the local municipality. (Serina Schoeman, interview, October 2003)

I Ms Schoeman commented on this statement: *It is true that no formal workshops were held regarding management of the preschool component of the project, but a workshop was held with the school staff. Secondly, notification of the MRC's withdrawal entailed more than the letter written to the mayor and informal discussions with the community. Discussions were held with the principal, staff and school governing body, Langebaan Primary School. In depth discussions and interviews between MRC staff and the community (clinic staff, the mayor, the school, church leader and volunteers) were also held regarding future management of the project. Either all the volunteers attended or were represented by Ms Ocks during these negotiations. One-on-one discussions and pamphlet distributions were done to all households and community leaders in March 1998, 12 months prior to the MRC's actual withdrawal. The final take-over culminated in oral presentations by the MRC, and speeches delivered by the mayor, church leader, a volunteer in Langebaan and was attended by representatives from the health and nutrition directorate, school, and community representatives, and Janssen-Cilag. A workshop with the volunteers on management of the preschool project was not deemed necessary since the volunteers' competency and the community's acceptance have been proven over the 3 years. Volunteer support and linkage with well-established resources were confirmed prior the withdrawal of the MRC through tacit agreement and acceptance of the responsibilities of the model by the mayor. Further, the support of the pharmaceutical company to provide deworming tablets at a reduced price was also agreed upon.*

During an interview Ms Schoeman was asked if she thought that it was characteristic of community projects that after an intervention, it would gradually disintegrate after you transfer knowledge and responsibilities, she explained that she believed that it would happen but that the MRC tried their best to ensure that the community knew exactly what to do.

That is why we wrote all these letters to the authorities within the community and they agreed to take responsibility. I think what is very important in community projects or community participation is a sustainable support structure, because once the support structure is lost, it is difficult for communities to function in isolation. (Serina Schoeman, interview, October 2003)

Another explanation might be that during the end of 2000, the municipal services had amalgamated and thereafter Langebaan resorted under the Vredenburg Municipality. The support structure of the Langebaan Municipality was therefore lost to the community. It was exactly at that time that the project stopped completely. A follow-up interview was planned with Mr Malherbe, the former mayor of Langebaan in order to get his perspective on why the project disintegrated. He indicated in a telephonic conversation that he was not part of the project and that he had no information about it².

The volunteers' main reason for the disintegration of the model was the lack of support from the sister at the local health facility.

I honestly think the sister wasn't very positive – it was the sister. She wasn't very positive with our work. She wasn't happy with our work in the clinic and felt threatened. The MRC had its own files and the clinic had its own files and then when the MRC left we had to write in the clinic files and she didn't like that. It went on like this for a while in the clinic – about two years – I worked on Tuesdays and Rhona worked full days, the whole week.. Look we had to work every three months when the pills had to be distributed and then it was a nuisance to her and later we started to ask if we don't have to work because it's time she said no the pills aren't here or it's not necessary. I was there once to ask her for the pills because the children must have it. So then we worked under pressure that month – that was the one time that I asked and her attitude wasn't nice. It started to cause conflict. She thought we were taking over the work of the clinic. (Focus group interview, November 2003 (translated from Afrikaans))

² One can therefore only make assumptions on possible reasons why Vredenburg Municipality did not provide Langebaan with a continuous support structure. Perhaps they were not informed about the project or perhaps they did not see why they should continue their support for such a project in Langebaan, when Vredenburg had their own problems to be addressed.

The women clearly felt disempowered after the MRC left. Although they were still very enthusiastic about the project, they did not have enough confidence to challenge the sister and furthermore, they had no-one to turn to for help. They did not turn to the MRC for assistance:

Look they left it in our hands and we just had to carry on. That gave a good feeling. And it's here that things went wrong. We felt that it should be sorted out here. (Focus group interview, November 2003 (translated from Afrikaans))

There was a definite change in power dynamics after the MRC left. This could possibly be one of the reasons why the women did not have the courage to voice their concerns:

It was a bit difficult you know, because we were distant. While we were around, these women really felt brave and they saw themselves as part of the powerful MRC – if I can put it in that way. And even if they would do a visit at a home in the community, then the people would refer to them as the MRC ladies or the worm ladies. That type of connotation was made so they were very positive and proud. I cannot say the same after we withdrew. To me it felt as if certain power were taken away from them and this could be because they did not receive all the support from the health facility and even from the local municipality. When it was taken over, they were not even paid on a regular basis. They had to wait for months before the sister gave them forms to complete for their salary and I think it also gave them a sense of 'we are no longer good enough. (Serina Schoeman, interview, October 2003)

This was confirmed by the volunteers:

We should have driven ourselves harder to continue but we felt that the sister had the knowledge and the municipality the responsibility. And our confidence – we didn't have it any more. The MRC also has more influence than us. (Focus group interview, November 2003 (translated from Afrikaans))

Although the volunteers were not able to sustain the project on themselves, they still feel responsible and their main concern is the health of the children of Langebaan:

My feeling is for the children – shame! And I think the worms are sky high again. It's most probably again 80% and it's such a pity. We had the best intentions but got no help. It's inhumane. (Focus group interview, November 2003 (translated from Afrikaans))

Ms Schoeman commented on the role of the MRC in the sustainability of the project even though it was not really their responsibility anymore:

Yes, but this would have meant further involvement from us. It was important for us to take the back seat and only avail ourselves on request to allow the community some freedom to drive the project in their own unique way. Maybe this was a bit naïve from us. Feedback sessions at least twice a year could have also allowed us to identify the gaps and to make suggestions or exchange ideas how to address the problems – this could perhaps have ensured sustainability. (Serina Schoeman, interview, October 2003)

She also stated her concerns about the support of the Department of Health:

If I should do a project like this again, I think I would go beyond getting a word-of-mouth agreement. I would ensure that the views of staff at operational and managerial level are equally well understood and supported and that both display a clear vision on the implementation and support of such a model. I will ensure that they view the health system as the primary link and support system of the volunteers. Although knowledge transfer to people is never a waste, the community's lack of support from top structures, or their inability to utilize the knowledge within the community or to manage it further, that is a problem. (Serina Schoeman, interview, October 2003)

Prior to the interview with the women volunteers, the sister at the local clinic was transferred and they now have a new sister. They seemed encouraged by the focus group discussion to initiate discussions with the new sister in an attempt to try to re-introduce the growth-monitoring and deworming system in the community.

I think we have to go talk to the new sister and tell her that we have all the knowledge – we had the training and we feel responsible. And it's proof that the project worked. We were so famous in our community as the health workers in the streets and so. We have to come together as a groupie and go have a nice talk with the new sister. (Focus group interview, November 2003 (translated from Afrikaans))

6 Lessons learnt from this case and concluding comments

One of the most important lessons learned from this case is that the potential success of research interventions in communities in terms of its ability to promote uptake, implementation and knowledge transfer to the community, depends strongly on the nature of the collaboration and communication between researchers and involved community members. It also depends on the expectations of all parties involved in terms of what outcomes the research should ultimately have.

In this particular case study, no formal structures were put in place to ensure the institutionalisation of the monitoring model in the community. It seems as if a miss-match existed between the goals of the project – on the one hand to see if a growth-monitoring model can in fact improve the nutritional status of children in a community and on the other, to successfully transfer the model to the community.

One could argue on the side of the MRC that, in the words of Ms Serina Schoeman they are not a service provider and therefore ultimately the research was primarily driven by the intellectual concerns of the researchers to produce new knowledge for the sake of the advancement of medical practices. However, one must not lose sight of the fact that this research was an intervention. It took place in the context of the community and therefore the responsibility of the researchers involved stretched further than only successfully establishing a growth-monitoring model. As researchers, they were also agents of change with a certain responsibility towards the people of Langebaan.

Some will argue that it is the nature of development projects that in terms of the sustainability of such initiatives, especially in the long run when the researchers have left the community, that what was developed (in this case a growth-monitoring model), will gradually disintegrate and the community will be left with how things were before the intervention. However, the author argues that in this particular case, if ownership of the intervention was clearly communicated beforehand and if collaboration was based on a formal, structured process developed by both the MRC and the community leaders, the intervention could have been sustained more effectively.

Furthermore, the issue of unequal power relations is very clear in this case. The community saw the MRC as a powerful body, able to improve the well-being of the community by means of transferring their knowledge to especially the women volunteers working on the project. It is clear that the researchers had a strong presence in the community that left a noticeable gap after their withdrawal. Perhaps the reason for the disintegration of the intervention was just this – that the women volunteers of Langebaan North depended too strongly on the direction given by the MRC and therefore their capacity to function independently as health workers in the community was not fully developed. Related to this is the fact that participation from the community only actively consisted of these women volunteers. The author's impression is that these were the only people from the community that actively bought into the project and continually tried to assist the MRC in their research. It seems as if the community leaders, the municipality, the local clinic and even the Department of Health were not as positively inclined throughout the intervention. One can only suspect reasons for this, one being the financial implications of running an intervention of this nature on a continuous basis in the community.

Despite this, this particular research had a definite impact in terms of initiating (even if only that) a transformative agenda in medical research by attempting to move away from curative research programmes to more preventative research practices. The facilitation of an independent and sustained growth-monitoring model at the community level definitely contributes to the achievement of national health objectives of improving community health through community participation, awareness- and capacity building.

This research project and the lessons learnt from this case can enable future, similar interventions to sensitise itself with, and actively think through not only research-based processes that determine success in terms of its contribution to scientific knowledge but also community-based factors that impact on its usefulness in practice.³

3 The draft case study report was submitted to Ms Serina Schoeman and she remarked as follows: *After the MRC's withdrawal, the CBGM comprised competent women, established points in the community from where the activities were performed, and an authoritative figure in the form of the local municipality as support system, which is the key elements for the sustainability of the model. I regard the infrastructure based on the above, as the key requirements to ensure the institutionalization and sustainability of the monitoring model in the community. The MRC cannot be held completely accountable for the disempowerment of the women that resulted in the disintegration of the model after the withdrawal. However, through the gradual disintegration of this model, the MRC has learnt an important lesson and would consider the following for similar projects in the future – 1) to go beyond word-of-mouth agreements, 2) ensure that the commitment and enthusiasm of staff at operational level (clinic sister) are equally well understood and supported at managerial level and political level for continuity, 3) allow a minimum period for follow up monitoring after withdrawal/transfer of project responsibilities should in terms of the above establish a system of intermittent monitoring for a minimum period (subject to the situation) after transfer of such models in future. One should also be realistic that even with these precautionary measures, success might not be guaranteed. In my opinion, community-based projects involving health or any other professional discipline would always require strong support from an authoritative figure due to the unequal power and knowledge distribution between the two components. The success and sustainability of community-based projects are largely determined by the integrity of professionals, their attitude, willingness to share power and their acceptance of the community as equal partner, which I consider more essential than a written agreement. The latter could create negative relationships and could be detrimental rather than beneficial to communities. In my view, despite the disintegration of the CBGM, the MRC has left the community in a much better position as on entry. The skills required by these women have left them better equipped, proud and positive and they are still motivated to utilize these skills in future. It is however, disappointing that the authorities concerned did not respect and keep their agreement of utilizing the model after the MRC's withdrawal. (October 2004).*

Data sources

Face-to-face interviews

Ms Serina Schoeman, project leader of the CBGM model in Langebaan, 21 August 2003 and 24 October 2003

Women volunteers of Langebaan North, 14-15 November 2003

E-mail responses to additional questions

Ms Serina Schoeman, 24 October 2003

Questionnaire

'Public sector R&D in South Africa: The production and utilisation of research' questionnaire completed by Serina Schoeman, March 2004

Publications and documents

Schoeman S et al (1995) *Research Protocol: A community-based nutritional status surveillance programme of preschool children in an urban community*, MRC: July 1995

Schoeman S. et al (1996) *Intervention Protocol: A community-based model for treatment of trichuriasis and ascariasis and growth promotion in children of the West Coast*, MRC: May 1996

Schoeman S (1997) Project progress report (unpublished), August 1997

Schoeman S (1997) *Interim Report on Mass Deworming and Growth monitoring of Children in a Community on the West Coast*, MRC: November 1997

Schoeman S. et al (2000) *A community-based growth monitoring model to complement facility-based nutrition and health practices in a semi-urban community*, Report, MRC, June 2000

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Other

Medical Research Council, <http://www.mrc.ac.za>

Various unpublished notes, email correspondence and letters.

CASE STUDY 10

RURAL SEED (SUSTAINABLE ENERGY, ENVIRONMENT & DEVELOPMENT) (PHASE 1):

Research and utilisation interwoven in practice

A participatory action research project, led by Mr Bill Cowan of the Energy Research Centre, University of Cape Town

by Tracy Bailey



Rural woman carrying firewood. Photograph courtesy of: Cowan B (2003) **Rural Energy Guide: An introduction to energy issues in rural areas of South Africa**. Cape Town: Energy and Development Research Centre.

CONTENTS

Abbreviations	431
1 Introduction	432
2 Organisational context: The Energy and Development Research Centre (EDRC).....	433
2.1 Vision and goals of the EDRC.....	434
2.2 Nature and organisation of the research	434
2.3 Linkages and collaboration	436
2.4 Funding.....	436
3 Overview of the Rural SEED project (Phase I).....	437
3.1 Initiation and conceptualisation of the Rural SEED project.....	438
3.2 Aim, objectives and methodology.....	441
3.3 Stages and activities in the evolution of Rural SEED (Phase I).....	442
3.4 The Rural SEED project team and other participants	451
3.5 Project funding	453
4. Modes and contexts of knowledge production and utilisation	453
4.1 The consultative, participatory and collaborative nature of the project process..	454
Broad consultation	454
Collaboration	455
Participation.....	455
Participation, collaboration and consultation in setting the research agenda and designing the project.....	456
4.2 The flexible project design.....	457
4.3 Characteristics of the research dimension	458
The more 'conventional' forms of research	458
Prior research and indigenous knowledge.....	458
4.4 Research and information outputs.....	459
The Rural Energy Resource Pack.....	460
The Rural Energy Information Kit.....	460
The Rural Energy Guides.....	461
The contract report.....	461
4.5 Communication and dissemination strategies	461
Newsletter	462
Popular media.....	462
Presentations.....	462
Policy briefs.....	462
Video footage.....	463
Web site.....	464
4.6 Features of the mode and context of knowledge utilisation.....	464
4.7 Strategies, agents and examples of knowledge transfer	465
The 'information bridge': Effecting better communication, information-sharing and uptake.....	465
Capacity-building in local communities and the energy sector.....	467

	Subsequent employment in the energy sector	468
	Feeding into postgraduate training and degree programmes	469
4.8	The rural poor as users: Practical developments in the pilot communities.....	469
4.9	Impact at the national government level.....	471
	The DME and Integrated Energy Centres (IeCs).....	471
	Other more limited policy impacts.....	474
4.10	Information base for energy activists.....	474
5	Concluding observations and lessons learnt from this case	475
	DATA SOURCES	478
	Face-to-face interview	478
	Telephonic interviews.....	478
	Email response to questions.....	478
	Questionnaire.....	478
	Publications and project documents.....	478
	Appendix: Examples of capacity building activities	479

Abbreviations

ANC	African National Congress
CBO	Community-based organisation
CRAET	Centre for Research in Appropriate Energy Technology
DANCED	Danish Co-operation for Environment and Development
DANIDA	Danish International Development Agency
DME	Department of Minerals and Energy
EDA	Environmental Development Agency
EDRC	Energy and Development Research Centre
EPRET	Energy Policy Research Training Project
ERC	Energy Research Centre
ERI	Energy Research Institute
IDP	Integrated Development Planning
leC	Integrated Energy Centre
ISRDS	Integrated Sustainable Rural Development Strategy
LPG	Liquid paraffin gas
NGO	Non-governmental organisation
RSF	Rural SEED Facilitator
SEED	Sustainable Energy, Environment and Development
UCT	University of Cape Town

1 Introduction

Energy is the basis of life. Without it, we would have no food, shelter or transport, no education and no health care. It is thus not surprising that wars are waged over access to energy. Think of the bloody conflicts over oil reserves in the Middle East. Think too of the battles being fought, by environmental activists and organisations around the world, over pollution, climate change and the hole in the ozone layer.

In the developing world, lack of access to sustainable and renewable energy sources is a critical problem for many people, and especially the rural and urban poor. Christopher Flavin (2002) refers to this phenomenon as “energy apartheid” and reports that 4 billion people in the world rely predominantly on unsustainable energy sources and a further 2 billion people lack access to electricity or liquid fuels.

Of course, this “energy apartheid” was no more apparent than in South Africa in the late 1980s, where access to energy services was deeply divided along racial lines. While the minority White population had immediate access to electricity, the Black population – many of whom lived in rural areas – “relied on less convenient but more expensive energy sources such as paraffin, coal, wood, gas, candles and batteries” (Hofmänner 1999:x).

It was in this context that the Energy and Development Research Centre (EDRC) was established in 1989, based on a desire to produce research, build capacity and engage with external stakeholders and local communities, in an effort to address these social inequities in relation to energy. Policy development and implementation by the new South African government has brought about some change and relief to the poorer people in this country with regard to their energy needs. However, last year Bill Cowan (2003:5) reported that only 50% of rural households in South Africa, compared to 90% of urban households, are connected to the national electricity grid. It is therefore not surprising that the commitment to addressing the energy inequities in South Africa continues to give the Centre its direction and focus.

This case study documents the initiation, progression, outcomes and utilisation of one of the research projects undertaken by the EDRC, which seeks to address the social inequities in energy services among the rural poor, namely the Rural SEED (Sustainable Energy, Environment and Development) project (Phase I). The Rural SEED project is a multifaceted endeavour. It is both action research and pilot implementation, aimed at improving energy services for low-income rural communities, in support of sustainable rural development. The project is undertaken in collaboration with local communities, non-governmental organisations (NGOs), energy suppliers and local and national governments. In addition, critical focal points of the project include capacity building among local and national government, energy suppliers and rural communities, and the facilitation of information flow between these stakeholders.

This case study report has two main parts. The first two sections develop a descriptive picture of the broader organisational context within which the project is located, and of the project itself. The second part of the case study steps back from these basic descriptions and considers the way in which the knowledge is produced, transferred and taken up.

2 Organisational context: The Energy and Development Research Centre (EDRC)

Over the past fifteen years, the Energy and Development Research Centre (EDRC) of the University of Cape Town has undergone changes in organisational structure, staff complement, institutional affiliation, name and research interests. The Centre was established in 1989 under the directorship of Professor Anton Eberhard. In those days, it was called the Centre for Research in Appropriate Energy Technology (CRAET) and was attached to the Energy Research Institute (ERI) in the Faculty of Engineering. As the name suggests, the research focus at that time was on ‘appropriate technology’, and specifically on how renewable energy could be used to assist rural areas.

In 1992, the Centre attained the status of a separate research centre (the EDRC) in the Faculty. In part, this development was the result of growth in funding and contract research that provided a financial basis for independence. In addition, opportunities for more policy-orientated research arose after the African National Congress (ANC) was unbanned, an orientation which ERI researchers were keen to avoid. Mr Bill Cowan, a researcher at the EDRC since its inception, described these developments as follows:

It was partly like a father-son situation: the son gets bigger and bigger and bigger and eventually it's better for him to leave the house and set up his own house. EDRC grew very fast, partly because there were imminent elections. There was this window of opportunity for doing policy research that had to be done on a large scale within a couple of years. So we mushroomed. There may also have been some sort of political-type reasons for the split in that the people at EDRC generally felt comfortable working in a field that would engage with politics and would be involved with advocacy, be involved with talking to political parties etc, whereas the more conventional engineering-type researchers, who dominated in the Energy Research Institute, were closer to the more standard university approach of “Let's stay objective and technical, not get involved with political issues.” (Bill Cowan, interview)

A significant EDRC policy research project in the early 1990s was EPRET – the Energy Policy Research and Training Project, funded by the Netherlands government. The project ran from 1992 to 1994 and involved a large team of people who engaged very closely with the energy sector (for example, with Eskom), with the African National Congress and the apartheid government.

With the change of government in 1994, the EDRC needed to rethink its role in the new dispensation, which they did once EPRET was concluded. Mr Cowan described the thinking at the time as follows:

Advocacy at a time of transition to democracy is quite different from advocacy towards a democratic government, and the thinking was from Anton Eberhard, the Director at that time, that we should step back and be more of a sort of critical, play a critical policy support role, rather than such an engagement and proactive role. (Bill Cowan, interview)

Ten years later, in a sense the EDRC has come full circle in its journey. The EDRC and the Energy Research Institute, both housed in the Faculty of Engineering and the Built Environment, (re)merged to form the Energy Research Centre (ERC), from 1 January 2004, under the directorship of Prof Kevin Bennett. Prof Ogunlade Davidson, the Director of the EDRC just prior to the merger, has since returned to Sierra Leone.

Despite these shifts and evolutions since its establishment, the EDRC appears to have retained a series of core foci, namely on producing relevant and useful research, on integrating postgraduate education into research activities, on building the capacity of a range of participants in the energy sector, and on developing and maintaining strategic alliances with local and international agencies, and with local communities. In addition, the EDRC continues to emphasise communication, dissemination and support to users – whether they be policy-makers in local and national government, energy suppliers, or rural and urban communities.

In the remainder of this section, a brief overview is provided of the vision and goals, research and teaching activities, funding, and linkages and collaboration of the EDRC, just prior to the merger. The focus is on the EDRC, rather than the current ERC, because the former was the organisational context within which the Rural SEED (Phase I) project was undertaken.

2.1 Vision and goals of the EDRC

The website¹ lists the vision and goals of the EDRC, all of which reflect the general orientation of the Centre described above:

- ◀ To be a leading African energy and development policy research, consultancy, and capacity-building institution
- ◀ To deepen knowledge and understanding of the energy and development needs and challenges in South Africa, the Southern African Development Community and the rest of Africa, and to search for innovative responses
- ◀ To contribute to improved social equity, economic efficiency, and environmental sustainability in the energy sector, through public-interest advocacy and understanding for policy-making and implementation, and
- ◀ To educate, train and develop human resources in the energy field.

The EDRC is therefore an organisation that emphasises relevant and useful research, social equity and capacity building.

2.2 Nature and organisation of the research

The EDRC staff is involved in a range of activities, including research that is orientated towards improving policies and implementation, consultancy work, advocacy and information dissemination, academic supervision and teaching, and training. The Centre's commitment to transformation and equity is visible in the descriptions of its activities.

As indicated in the introduction to this report, the EDRC was established during the period of transition in South Africa, a time when access to sources of energy was still

¹ <http://www.edrc.uct.ac.za/>

clearly divided along racial lines. Early research at the EDRC therefore focused on documenting and understanding the energy needs and problems of the rural poor. With the unbanning of the African National Congress in 1990, the EDRC extended its activities to providing research assistance to the mass democratic movement in the formulation of energy policies. Once the ANC government was in place, the EDRC continued to assist policy-makers. According to Hofmänner (1999:x): “The key issue that needed to be addressed within this energy system was a more equitable access to energy services for poor urban and rural areas.” The EDRC initiated a process of energy policy development by assisting the new government to develop an Energy Policy Discussion Paper, and later made important inputs into the White Paper (Hofmänner 1999:xx).

The EDRC web site characterises the Centre’s approach to research as “cross-disciplinary” and as “reflecting a sectoral and problem-solving orientation”. The qualifications of EDRC staff reflect this multi-disciplinarity, with researchers coming from backgrounds in engineering, natural and environmental sciences, urban and regional planning, economics, politics, law, sociology and anthropology. Overall, the EDRC’s research projects have a policy and capacity-building focus, with an emphasis on investigating means to improve social equity, economic efficiency and competitiveness, and environmental sustainability in the energy sector.

Prior to the merger with the Energy Research Institute, the research programmes of the EDRC included the following:

- ⤵ Energy and climate change
- ⤵ Energy, markets and governance
- ⤵ Energy, poverty and development², and
- ⤵ Co-operative Assistance for Rural Energy and Development in Africa (CAREDA), which is a crosscutting theme.

These research programmes are carefully structured. Each has a programme leader who is responsible for providing intellectual leadership, mentoring and supervision, programme-level strategic planning, and the negotiation and management of contracts and fund-raising. Each research programme also has a strategic plan, which specifies the vision and mission of the programme, provides an analysis of the fit between sector needs, funding, and the available skills base in the programme, and which outlines the targets and outputs of each of the research projects (Hofmänner 1999:ix).

Postgraduate education and training programme

The EDRC offers research Masters and PhD degrees, as well as a Masters programme in Energy and Development. This Masters programme consists of a series of taught modules, a self-study project, and a research dissertation. The modules offered are drawn from research programme areas of the Centre, and students are encouraged to undertake research topics that are linked to current EDRC projects. The EDRC web site indicates that former postgraduate students from these Masters programmes have entered a wide

² The Rural SEED project falls within this Programme.

range of careers in the energy sector, such as in government, industry, non-governmental, research and consultancy positions.

From time to time, the EDRC also offers other training programmes that aim to develop people for a transformed South African energy sector, and to build capacity in the rest of Africa.

2.3 Linkages and collaboration

Linkages and collaboration with a range of other institutions and organisations form part of the EDRC's strategic vision. Such partnerships and alliances are seen to enhance the Centre's ability to achieve project objectives and contribute to the growth of knowledge, skills and capabilities within the Centre.

The EDRC has a number of linkages both within the University of Cape Town, and with external stakeholders. Within the University, the EDRC collaborates with a range of faculties and departments, often in the form of joint undertaking of programmes and projects on a number of energy themes. The Dean's office in the Faculty of Engineering provides assistance with the general co-ordination of linkages with other University bodies on issues of academics, research, consultancy and administration.

Outside the University of Cape Town, the EDRC collaborates with a number of local and international institutions and agencies. In South Africa, the EDRC has linkages with academic institutions, Parliamentary Portfolio Committees, the National Climate Change Committee, government ministries, departments and regulatory bodies, South African NGOs and international organisations based in South Africa, and the private sector. The EDRC also has collaborative arrangements with a number of energy and climate change organisations on the African continent, such as the Environmental Development Action Tiers Monde of Senegal, the Kumasi Institute of Science & Technology of Ghana, and the Centre for Energy Environment Science & Technology of Tanzania.

2.4 Funding

Funding of the EDRC's activities has changed over the years. During the first five years of its existence, the Centre (then the Centre for Research in Appropriate Energy Technology) received core funding from the National Energy Council – a statutory body that was discontinued in 1992. CRAET was originally set up as a Centre of Excellence – a contract between the University of Cape Town and the National Energy Council.

During this time, the Centre also began to take on contract research. This, together with a core grant received from the Netherlands government, enabled the Centre to pursue its goal of becoming a separate research centre at the University of Cape Town. Over the years, the proportion of core funding has continued to decline and the Centre has increasingly engaged in commissioned research. Alexandra Hofmänner highlights the tensions and opportunities, which arose for EDRC staff in this funding context, in the 1999 anthology of EDRC research:

[] contract research is more goal-directed, time-pressured, market-related and leaves little room for open-ended studies, peer-reviewed publications, and teaching/training activities. [] The increase of contract research clearly

put constraints on the institution's mission to develop capacity and offer postgraduate education and training programmes. [] On the other hand, the advantages of contractual research offer a variety of opportunities. Among these, the stimulation of networking between different agents and stakeholders around energy issues seems to have been especially significant for the case of the EDRC. (Hofmänner 1999:xxi)

Today, the EDRC website lists an impressive array of local and international funders and research clients, including: the National Research Foundation, the Department of Minerals and Energy, Eskom, the Independent Development Trust, the governments of Lesotho, Namibia, Mozambique and Swaziland, the International Energy Initiative, the International Development Research Centre, the United Nations Development Programme, the Royal Netherlands Embassy, the Norwegian Agency for Development and Cooperation, the Danish Cooperation for Environment and Development, the European Union, the Organisation for Economic Cooperation and Development, the World Bank, and the International Energy Association. The EDRC does not, however, seek much funding from the private sector:

We very seldom, if ever, as far as I know, I'm speaking for EDRC, not ERC, contract to individual private sector companies. No strong reason for that but I think it's because we want to keep a public interest profile. We wouldn't like to be seen to be promoting the interests of one commercial organisation. (Bill Cowan, interview)

In summary, the EDRC appears to be a centre that has remained committed to its original goals, which included addressing the social inequities in energy services, building the capacity of policy-makers, planners, suppliers and researchers in the energy sector, and that of poor communities, and facilitating a flow of information between these stakeholders. Informing policy and supporting implementation are explicit foci of the Centre's research, as are interdisciplinarity, communication and dissemination, and strategic alliances and partnerships at all levels. At the same time, the Centre has remained flexible and responsive over the years. Of particular interest to this case study is that the Rural SEED project reflects all of these values and approaches in its design and its implementation. A detailed description of the Rural SEED project (Phase 1) is provided in the following section.

3 Overview of the Rural SEED project (Phase 1)

The SEED (Sustainable Energy, Environment and Development) Programme is the umbrella structure within which the Rural and Urban SEED projects are located. The Programme was sponsored by DANCED (Danish Co-operation for Environment and Development). The Rural SEED project (Phase 1) began in 1998 and was completed in 2003. Originally, the SEED Programme was to run for about five years, and Phase 1 of the Rural SEED project for about two and a half years (October 1998 to April 2001). This did not come about however. Bill Cowan describes what happened as follows:

[] arrangements for Phase 2 became uncertain when DANCED was absorbed into DANIDA late in 2001, following the change of government in Denmark. In order to get greater value from Phase 1, and possibly increase the chance of continuity to Phase 2, DANCED invited time-extensions of

Phase 1, within the approved budget. In terms of these extensions, the closing date for Phase 1 was extended to February 2002, and later to April 2003. There was a period, roughly February 2002 to October 2002, when the project was dormant, due mainly to changes in staff in the Royal Danish Embassy / DANCED / DANIDA during restructuring. (Cowan 2004:1)

The project Completion Report was finalised in 2004.

In a nutshell, the Rural SEED project involves action research and pilot implementation, which is aimed at improving energy services for low-income rural communities, in support of sustainable rural development. Rural SEED is a widely collaborative endeavour, which emphasises capacity building and the flow of information between stakeholders at all levels. A large proportion of this case study is devoted to unpacking and detailing what each of these facets of the bigger project mean in this context, how they unfolded and what successes and failures have been experienced. In this section a descriptive snapshot of the Rural SEED project is provided – how and why it was initiated, who is involved, how it is conceptualised, its aims and objectives, and how it was funded.

3.1 Initiation and conceptualisation of the Rural SEED project

The very notion of a project like Rural SEED was the result of a convergence of individuals, ideas and opportunities. In 1995, DANCED sponsored an early investigation in South Africa, in order to identify promising opportunities for Danish assistance. Members of the Danish mission to South Africa emphasised initiatives which could both assist development among poorer communities as well as reduce energy pollution, for example, through greater use of renewable energy and improved energy efficiency (Cowan 2004:2).

At that time, Mr Bill Cowan, who had been a researcher at the EDRC since its inception, put forward an initial concept proposal for a project based on his and other EDRC staff's prior work in the field.³ Mr Cowan described this process in the interview as follows:

I think it came from a few different directions. It's a project to do with energy and, before this project started, some of the areas of work we'd been involved in [was] research to help the formulation of government energy policy – for the new government. And my particular angles of work were to do with renewable energy programmes, electrification of schools using solar systems, and designing approaches for large-scale solar electrification. And in the course of that work, I got a bit worried that there would be a gap between very progressive energy policies and intentions of the new government, and practical benefits for people, because a lot of the initiatives were supply-driven programmes. So, there would be targets like electrifying a thousand schools, and the teachers wouldn't be consulted, and the solar systems wouldn't be used. So, I thought there would be good scope for a project that would try to fit between the supply programmes and policies, and rural communities who were the intended beneficiaries.

³ Two of the relevant EDRC research projects here include: D Banks, W Cowan & P Geerdts (1996) **Solar Home Systems: Techno-economic study**. Energy and Development Research Centre, UCT. Prepared for Department of Minerals and Energy, Pretoria; and, Cowan W (1998) **Improved energy for rural schools**. EDRC, UCT. Prepared for the Independent Development Trust, Cape Town.

[] *The work with rural communities, it wasn't just me. Of course we had quite a big research team at that stage, around about 30 people, of which maybe five or six were working very systematically with rural electrification issues. And we would have lots of discussions about all the issues that came up. We were all quite concerned that this target-driven approach of saying "Let's electrify as many houses as possible, as quickly as possible", wasn't having such good development benefits as people were hoping for. And so, people were doing detailed case studies about how rural communities were experiencing this process, what the problems were, and so forth. So it wasn't just my own interaction or my own projects but the whole body of work being done at that time. (Bill Cowan, interview)*

Mr Cowan developed the concept proposal further in collaboration with representatives of Danish NGOs, who had a history of working in Southern Africa. During this time, an urban component was proposed which would focus on sustainable energy practices in the context of low-cost housing projects. The Energy and Development Group, EDG (also based in the Cape) was contracted to manage the urban component. The rural and urban arms of the SEED project would share a steering committee and parallel reporting structures. This development effectively changed Mr Cowan's original proposal:

Originally my proposal was to work jointly on rural issues between South Africa and Zimbabwe. But when this other part of the project was added and the budget went over the roof, that regional collaboration part was largely cut out. [] We were also advised that the project was so ambitious that we would have our hands full just working in South Africa. And also for budgetary reasons. The project was split up into phases and the idea was that at the end of the first phase we could reconsider the regional cooperation possibilities. (Bill Cowan, interview)

The next step was the project design phase⁴, which was sponsored by, DANCED and contracted to the EDRC, in collaboration with the Danish Organisation for Renewable Energy, the Forum for Energy and Development, and the Danish International Human Settlements Service. In designing the project, the group of collaborators consulted with government, industry, local governments, energy organisations and NGOs, to test their proposed ideas and look for additional suggestions. For example, ideas and objectives were discussed with members of the national Department of Minerals and Energy:

We went to the Minister and said, this is roughly what's happening (quite an early stage), how would you like us to go forward? How do you think we can best contribute to the Integrated Sustainable Rural Development programme? Then [the Minister] gave us quite wise guidance. (Bill Cowan, interview)

⁴ In DANCED terminology, the Project Design Phase is a distinct phase in project development, which follows other elements such as project identification missions, sometimes a "clustering" analysis (which seeks to get synergies between a group of project ideas and DANCED-South Africa strategic priorities), concept proposal development, and provisional concept proposal approval. The Project Design Phase is a period where a full Project Document is developed. This is then followed by a Project Appraisal Phase, where another team of consultants appraises and modifies the project design. In fact the project design continues after the start of the project, since an Inception Phase is built into the first few months, in order to adjust the earlier design to fit any new circumstances. (Bill Cowan, e-mail, 3 September 2004).

It is also clear that the particular conceptualisation of the Rural SEED project was located within a broader movement around the world, which embraces and promotes concepts and approaches such as sustainable development, energisation rather than electrification, integrated energy services, and renewable energy.

Mr Cowan described these international trends as follows:

There's part of a debate that's being going on since the early '90s, saying that electrification isn't enough, it doesn't reach the rural poor, they can't afford to cook with it. And what you need is, what's often called 'energisation', which is to supply a mixture of different fuels. I think that started in South Africa. That's where I first heard the term. But that spread, partly through multinational organisations, to places like Kenya and elsewhere. You know there's a whole moving ideology that gets carried around by consultants, researchers, World Bank, other funders. They look at projects, they look at what's working, what doesn't, they change their ideology a bit. And this energisation was part of that. Similarly the idea of Energy Centres, it's located within a kind of a Local Action framework, with environmental aspects, so a sort of LA21 type of framework. Also in Denmark there've been Energy Advice Centres, that was another influence. (Bill Cowan, interview)

The proposal the team put together was beyond DANCED's envisaged budget. Mr Cowan explained how this problem was dealt with:

We put together a team of about five people and worked very hard for probably about three months to design the project. We ended up with a huge project document and we had been, we'd either been misinformed or we'd misunderstood the kind of budget that DANCED was expecting and we ended up designing a project that would have cost twenty million, which we thought was a little bit much, by four million or so! But then DANCED said no, actually maybe ten million would be maximum. [] So DANCED appointed another mission, the project appraisal mission, which is standard practice, who were given the additional brief of, if they thought this project was okay, cut it down to size from twenty-four million to ten million. Now that was ten million for the whole SEED programme, the urban part as well as the rural. And they did that. (Bill Cowan, interview)

All in all, the project preparation phase took about four years!⁵ Mr Bill Cowan made the following comments in this regard:

It was very complex. It also involved a lot of consultation and then finally the DANCED project design process is – if you carry it out properly – is very time-consuming, involving various stages of design and appraisal, with revisions and so on. [] Part of the reason for the lengthy preparations was a fairly thorough application of the LFA [Logical Framework Analysis] approach to project design. Like many international donors, DANCED adopted an LFA approach to project design requirements, project implementation and

⁵ This reference to the "project preparation phase" includes the development of the initial concept proposal and the full proposal (1996-1997), as well as the DANCED project design phase (1997-1998).

reporting. This was hugely time-consuming but certainly valuable in the project design stage. The many months and even years that went into the project design paid off later, through having a careful plan and rationale for the project. (Cowan 2004:4)

It is also interesting to note that Mr Cowan was not paid for all this preparatory work. He commented that it was a “big financial commitment” and that he had used his sabbatical to earn extra money through consultancy projects in order to cover his salary and other costs. Furthermore, Mr Cowan faced some resistance from within the EDRC to pursuing a project of this kind:

There was also heavy resistance within EDRC to this project. Certainly not from everyone, but from quite a few people. The main reasons were it looked like it was too applied, it was going in more of an NGO-type of direction, and the Director of EDRC at that time wanted EDRC to be a cleaner kind of policy-oriented organisation. In the past EDRC has done work like this, like ten years ago. So, in a way we'd been through that phase and left it. Once the project was underway, the opinions changed radically, 'cause then people saw what a powerful link there was between this NGO-type work and policy influence. (Bill Cowan, interview)

3.2 Aim, objectives and methodology

The primary aim of the Rural SEED project was to assist low-income rural communities to improve their energy supplies and their uses of energy, in ways that contribute to sustainable rural development (Cowan 2004:1). The project was conceived as a pilot implementation project, in the hope that the experiences and practices could ultimately be implemented elsewhere. In this sense, the project was intended to be “catalytic”.

In keeping with many rural development projects of this kind, the methodology adopted was that of participatory action research. As such, the project design was very open-ended and the objectives were broad and vague. In particular, the broad aim of the project was translated into two sets of objectives.

The first objective is effectively a **long-term development objective**, namely that environmentally sustainable energy practices are increasingly integrated into rural development projects in South Africa. This objective was not viewed as something that would be achieved directly by the project. Instead, it was viewed as an “orientating goal”, the idea being that if the project was successful, “it should make a contribution towards this longer-term objective” (Cowan 2004:41).

The second set of objectives were more **immediate objectives**, formulated as expected outcomes, namely

- ◀ South African non-governmental organisations, community-based organisations, local authorities and implementing agencies in selected local pilot areas have increased capacity in planning and implementing sustainable energy initiatives, with special focuses on rural integrated development projects; and

- Strengthened information dissemination, awareness building, and policy development in the field of sustainable energy are achieved at South African government institutions, parastatals and other organisations operating at national level and impacting rural energy initiatives (Cowan 2004:41).

Mr Bill Cowan, the project leader, describes these broad objectives in the final report as follows:

[Rural SEED's] first main objective was to support local capacity to integrate improved, more sustainable energy practices in rural development, in selected pilot localities. The aim here was to work in partnership with CBOs, local NGOs and local authorities, in order to identify local energy needs and to plan solutions. Secondly, the project had national-level objectives – to foster better linkages between national-level agencies (government, other energy planners, energy supply companies and parastatals) and local communities, in the hope of improving local service delivery methods, and of establishing useful methods for community-public-private partnerships, which might be replicated elsewhere in the country. (Cowan 2004:10)

In the spirit of participatory action research, the idea was that the Rural SEED project would provide a facilitatory framework within which capacity could be built and information could be disseminated among role players within the rural communities and in the national energy sector. Beyond these, however, the finer details of what this project would ultimately entail emerged through the participation of all the stakeholders during the course of the project.

In the following section, a synopsis of the rollout of the proposed strategies, and highlight some of the developments – within the pilot communities, and in other parts of the energy sector – which followed from these activities is provided.

3.3 Stages and activities in the evolution of Rural SEED (Phase 1)

The following account is based primarily on the narrative description of the unfolding of Phase I of the Rural SEED project, with particular emphasis on the various stages of forming rural energy development co-operatives, as outlined in the Completion Report (Cowan 2004:10-22). The reader should note that while some of the developments described below were chronological events, others were crosscutting activities that took place throughout the course of the project (for example, engagement with local, provincial and national governments, and training workshops and awareness campaigns). In addition, some of the stages described below were part of the original project design (such as selecting suitable pilot areas, and recruiting and training Rural SEED Facilitators), while others were the outcomes of these facilitatory and preparatory activities.

Before proceeding with this narrative, and by way of summarising the project process, two diagrams are provided below. The first, Figure 1, shows the final structure of the Rural SEED project (Phase I) as depicted in the Completion Report (Cowan 2004:7). This diagram highlights the three parallel focuses of the project, namely activities within the local pilot communities, the information bridging activities, and activities at the national

level. The figure also indicates, via arrows, the flow of information between groups and between different aspects of the project.

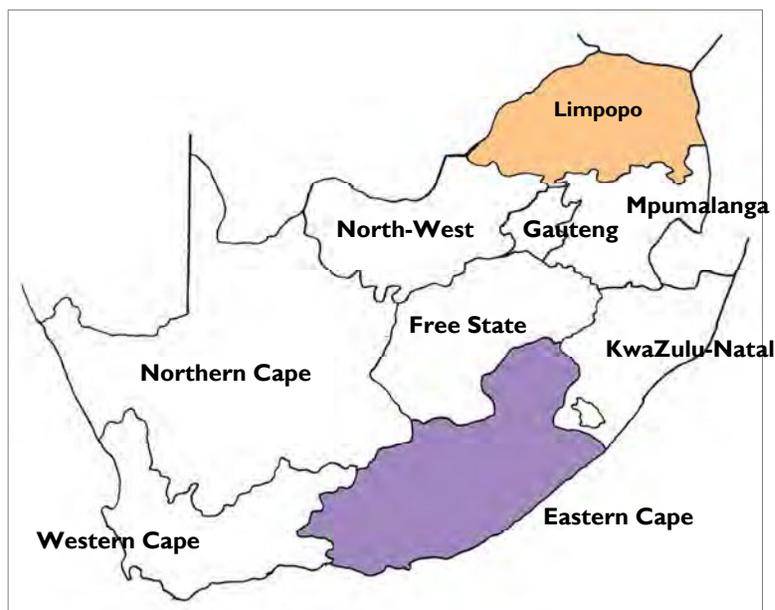
In Figure 2, an attempt (with assistance from Mr Cowan) is made to ‘map’ these various stages and activities within the Rural SEED process along a timeline. The diagram also summarises the key developments within each stage that are described in the narrative that follows. It should be noted, however, that given the crosscutting nature of some of these activities, and the different developments in the pilot areas, it is not a simple task to attach timelines to specific activities. Figure 2 thus provides a rough sense of the time periods involved.

Figure 1: Rural SEED project (Phase I) project structure



Source: Cowan (2004:7)

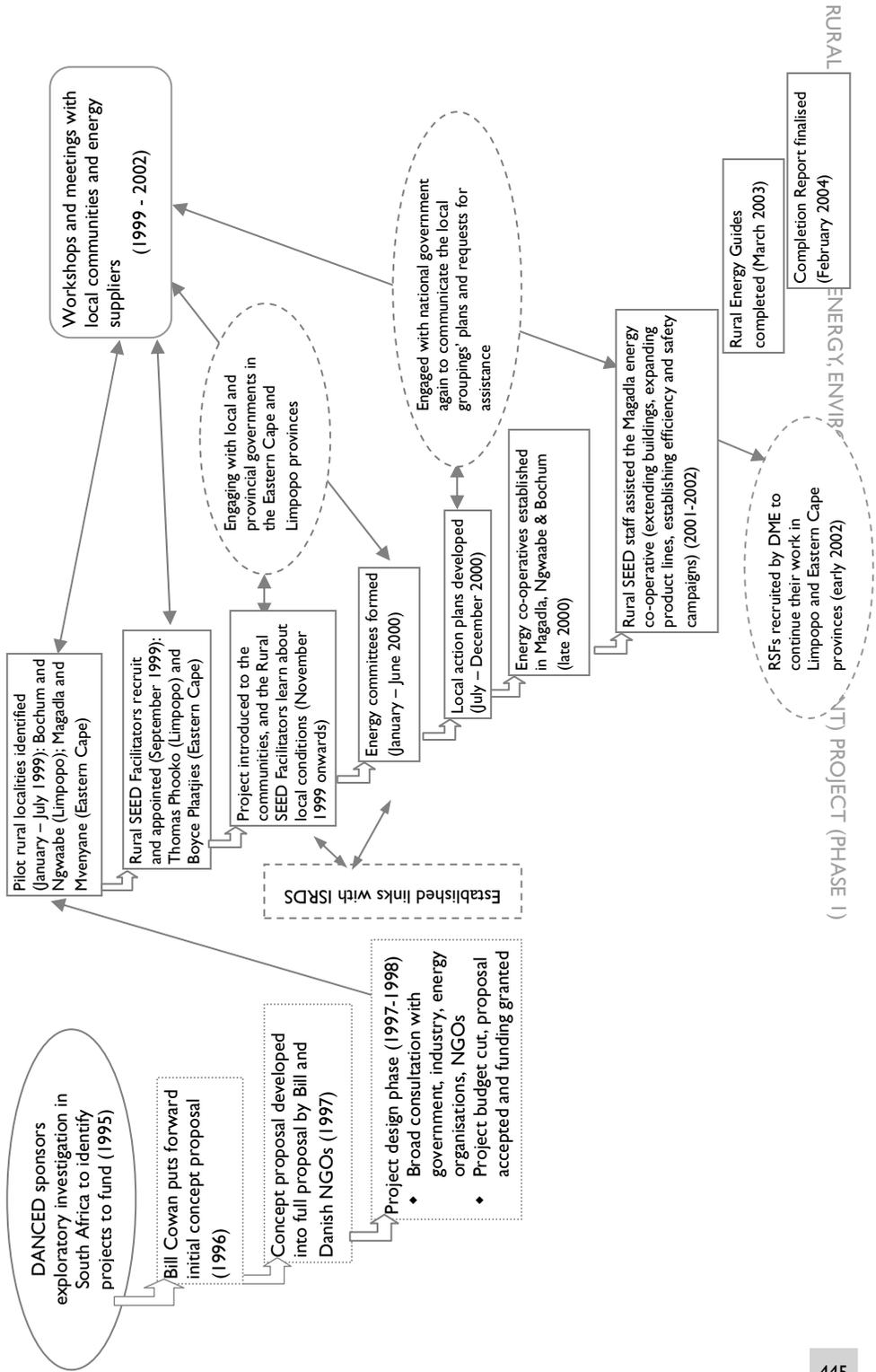
Location of the pilot communities in Rural SEED (Phase I)



The first step in the Rural SEED project was to identify suitable rural localities where Rural SEED could work, in partnership with community organisations and local authorities. This process took between six and nine months in the Limpopo and Eastern Cape provinces – both of which are regions characterised by large rural populations and urgent development needs. The village localities where Rural SEED came to focus its community-based activities included Bochum and Ngwaabe in the Limpopo province, and Magadla and Mvenyane in the Eastern Cape province. During this time, the EDRC entered into a partnership with the EDA (Environmental Development Agency) Trust, which offered to work co-operatively with the EDRC in the two provinces.⁶

⁶ A memorandum of agreement was signed with the EDA in September 1999.

Figure 2: Stages in the evolution of the Rural SEED project (Phase I)



The next step was to recruit Rural SEED Facilitators who would be “able to work creatively and harmoniously” with local communities, community-based organisations and authorities (Cowan 2004:11). In a national recruitment effort, in which more than forty potential candidates were identified, Mr Boyce Plaatjies and Mr Thomas Phooko were selected as Rural SEED Facilitators.⁷ The two Facilitators underwent training for a period of six weeks. Training was provided by staff and associates of the EDRC, and focused on rural energy issues, current energy policies and programmes in South Africa, and participatory methods to help identify local energy needs and options.

The Rural SEED Facilitators’ point of departure was to begin to learn about local conditions, organisational structures, and energy needs and opportunities of the communities within which they were operating.⁸ During this time, the Facilitators introduced the Rural SEED project to these communities, via informal and formal meetings with community groups, local authorities (traditional and elected), and provincial government departments.

Once these initial tasks were completed, the Rural SEED staff began to run what would ultimately amount to approximately 200 workshops and meetings with local, provincial and international stakeholders. The purposes of the various workshops are described in the Completion Report as follows:

In the early stages of the project, workshops served to introduce the project, draw out local people’s experiences of energy problems, raise awareness about energy issues (and how they are connected with many other aspects of rural life and rural development), and to bring together and resolve sometimes conflicting viewpoints and interests. [] Later in the project, local workshops provided opportunities for energy suppliers, planners and policy-makers to come and speak to people, describing what they could offer and explaining their own plans and programmes. Collective problem-solving workshops were used to draw up priorities for local energy action plans. Workshops were also used for purposes like training youth groups to carry out energy safety campaigns in the district (through drama), exposing youth representatives to wider energy sector issues (with the Department of Minerals and Energy and the South African National Energy Association) and to train community members in the establishment and operation of community co-operatives. (Cowan 2004:11-12)

The next step was the formation of energy committees in the pilot areas. The Rural SEED project team either identified existing rural community structures with which they could work, or, where necessary, facilitated the establishment of new ones. As Cowan (2004:13) explains, “In each case an important principle was to try to strengthen existing

⁷ Boyce has a background in theology, rural development studies and community work, and Thomas has a background in development studies, energy-policy training, labour union work and consultancy. The Rural SEED Facilitators were employed on the project from September 1999 to April 2002.

⁸ This study was published as follows: W Cowan, D Banks, N Mohlakoana & L Tyani (1999) **A preliminary investigation of energy needs, energy supply initiatives, and opportunities for improvements in the Maluti and Mount Fletcher districts of Eastern Cape**. Energy and Development Research Centre, UCT.

organisational forms, and in cases of existing conflicts of interest, try to promote synergistic roles and cohesion.”

Once the project had started within the selected communities, the project was discussed with representatives of the local and provincial governments in the Eastern Cape and Limpopo provinces. According to Cowan (2004:16): the “... links with local government remained important during the development of energy committees in local communities, and throughout the project.”

The national government was re-engaged, this time more substantially, once the local community groups had established an action-base. These local groupings’ intentions and requests were communicated to parliament via a number of presentations to the Parliamentary Portfolio Committees for Minerals and Energy, and Environment and Tourism, to the Minister of Minerals and Energy, and to members of the Department of Minerals and Energy (DME). These linkages were strengthened by the participation of a DME representative and an ANC parliamentarian on the SEED Programme Steering Committee.

At the same time, community groups in the pilot areas began to develop local action plans, steered by the energy committees and assisted by the Rural SEED Facilitators. Workshops were held during which community members identified and listed their energy problems, identified the causes, and formulated priorities and steps for action (see Box 1). A common concern and top priority for action emerged, namely to obtain cheaper and more convenient supplies of paraffin locally.

Box 1: Common themes that emerged during the workshops

Household fuels and appliances: “bring them closer” (increase access, reduce costs, increase choice), and “make them safer” (through awareness workshops, safety measures, improved quality control, etc.).

Income-generation: a very high priority was to obtain better energy supplies for more productive income-generating activities (e.g. non-toxic heating and lights for poultry projects, fuels for bakeries, electricity for mechanised production and for irrigation, etc.).

The idea of establishing local energy centres or depots, which could provide local supplies of fuels and appliances as well as take on a number of other information and development-assistance functions.

Source: Cowan (2004:16)

Stemming from these efforts emerged the idea of establishing village energy centres, or depots “which could provide local supplies of fuels and appliances as well as take on a number of other information and development-assistance functions” (Cowan 2004:16). The adoption of this particular approach appears to have been the result of a number of events and situations, involving members of the Rural SEED project team and the pilot communities. Cowan (2004:17) notes that the ideas for “gaining cheaper supplies of fuels like paraffin by means of bulk-buying and local distribution” or for “having rural energy centres (or rural energy stores) that could provide a range of energy-related goods and services” were not new in South Africa, and had, in fact, been discussed for several

years. Mr Boyce Plaatjies, the Rural SEED Facilitator in the Eastern Cape, reported that he and others had encountered this idea, and seen it in practice, on their study tour to Denmark in 2000.

In the meantime, the project staff had been engaging with the pilot rural communities about their energy use patterns, and energy needs and problems (as outlined above), and particularly around the options they had in terms of solutions. According to Mr Plaatjies, the Rural SEED staff suggested the idea of establishing energy centres to the communities, as a possible solution. The concept appeared to fit very well with existing ideas and initiatives within these communities. In particular, Mr Plaatjies observed that by the time the Rural SEED project entered the field, there was some organisation at the household level in these rural communities aimed at stimulating economic development activities. What was missing from these initiatives was a vehicle to drive the process, and the communities quickly saw the potential role of the energy centre as this vehicle.

People had already organised themselves [particularly the people in Matatiele], sort of like a club where households in the village were paying a certain amount every month, with the idea of when they generated enough they can start up programmes in their areas. But at the time of our intervention that was not yet grown enough and they lacked a vehicle to take those ideas further. Then when the SEED programme came in with this energy agenda then we went through with them in terms of identifying their energy needs in the areas and ran workshops in terms of having seen these problems that we experienced around energy, particularly affordability and access to energy, how can we go about doing this, to make more energy affordable and accessible to you? Then the energy centre concept came up as the one where the bulk supplies of paraffin and other sources was the idea, but that linked very well with their ideas because inasmuch as we access and make energy more affordable, according to them, that was going to be a vehicle to also realise their initial ideas about local economic generation around the community, like having these things sold; it will create more jobs for the people because it will be closer to them and it will be run by them, generate money to start other programmes. (Boyce Plaatjies, interview)

In the context of the Rural SEED project, where the initiative for establishing energy centres was community-based, there were two clear emphases: firstly, these centres should have both commercial and non-commercial (e.g. awareness campaigns) purposes, and secondly, that ownership and governance of the centres should bring community-wide benefits, rather than benefiting a single company or entrepreneur.

It is important to note that during all of this time, the South African government was formulating its new *Integrated Sustainable Rural Development Strategy (ISRSD)* and the idea of community-managed energy centres fitted well with a number of the principles of the Strategy. The Rural SEED project therefore also established links with the emerging ISRSD (see Box 2).

By this stage, the broad framework for Phase I of the Rural SEED project had been established: pilot communities had been selected and Rural SEED Facilitators had been recruited and trained. Appropriate community structures had been formed, and action plans had been developed. Significantly, the operating concept of ‘village energy centres’ had been adopted and communities were in a position to begin to take practical steps in this direction.

The first practical step taken related to the goal of improved paraffin distribution. Community groups (with the assistance of project staff) began enquiries and negotiations with oil companies. The second step was to identify organisational structures (or establish new ones) that could take legal responsibility for contracts, bank accounts, and so on. In most cases, these were community-based co-operatives, and three such energy-development co-operatives were formed and registered in Magadla, Ngwaabe and Bochum. Start-up capital was generated through membership fees, and active community members were provided with training in, for example, setting up co-operatives, drawing up constitutions and business plans, and book-keeping. Finally, premises for these co-operatives were identified and construction of the buildings commenced.

Again, current developments elsewhere facilitated the adoption of the ‘co-operative’ approach. Mr Platjies explained as follows:

Then the question with [the communities] was that, if we could get this paraffin close by, because it costs us if we go to town and buy it, it is very expensive. If we can get it closer to us, that could be an idea. We went further in interrogating the concept in terms of how do we do that then? Do we have to talk to these petroleum companies to come and have those mini shops of theirs here, and the business be maintained by them, and just have extended vendors to reach the communities? And the communities said no, let's not approach it like that, because we have this idea of creating income-generating projects in the area, and also creating jobs. How about us forming a co-operative where we buy the paraffin and those kinds of things from these companies then we sell it to the community; not them having, for example, a spaza shop here to deliver, you know, a distributing chain. [] During that time, there was a conference that was held in the University of Transkei, by the Premier's Office, looking at economic generation in the Eastern Cape, and in that conference, one of the major things that was raised that needed to be revived, was the co-operative movement, to be revived in the Eastern Cape. They saw it as the best vehicle in terms of driving development, to encourage people to form co-operatives. And that mode, coupled with the Denmark experience, then we said, guys, this could be, because it is in line with what our government in the Eastern Cape is doing, it could be easy for us to get funding and support, because it's what they want, to go this route. (Boyce Platjies, interview)

After this point in the project, these initial steps evolved in different ways in each of the village districts. These developments are discussed in detail in Section 5 of this report, when they are drawn upon as examples of application and implementation.

Box 2: The Integrated Sustainable Rural Development Strategy

According to David Everatt (2003), the government's ISRDS was developed between October 2000 and February 2001, and grew out of a range of prior initiatives, starting with the Reconstruction and Development Programme in 1994. The ISRDS was launched in 2001, and the key elements behind the vision of the Strategy are described in the November 2001 document as follows:

- "Rural development: Rural development is multi-dimensional and much broader than poverty alleviation through social programmes and transfers. It places emphasis on changing environments to enable poor people to earn more, invest in themselves and their communities and contribute toward maintenance of key infrastructure; a successful strategy will make people less poor, rather than more comfortable in their poverty.
- Sustainable: Sustainability is derived from increased local growth, and where rural people care about success and are able to access resources to keep the strategy going.
- Integrated: Integration is complex and requires effective co-ordination across traditional sectors in all levels of government. The Integrated Development Plan (IDP) process will establish a primary locus of integration at the municipal level.
- Rural safety net: Safety nets are still needed, and South Africa is exceptional amongst developing countries in that many of the key programmes of social assistance extend to rural people and prevent much hardship. The findings of the current review of social assistance should be incorporated to complement the ISRDS." (ISRDS 2001)

The national Department of Provincial and Local Government is the co-ordinating government body for the Strategy.

The operational approach of the Strategy:

"It will build immediately on existing programmes of government through a well co-ordinated, bottom-up approach to rural local economic development. Key government initiatives will form a core of the integrated programmes on which ISRDS will be built. An initial focus will be on a manageable number of selected areas, or nodes, where the process at a local level will be guided. The range of programme options will be customised in each node into a 'basket' of services. The selection will be based on participatory decision-making at a local level and will include resources from government and other social partners. The chief instrument for integration will be the mechanisms of IDPs as provided for in the Municipal Systems Bill." (ISRDS 2001)

Thirteen rural nodes have been identified nationally, which will serve as pilot areas for future expansion of activities. The ISRDS has since been renamed the Integrated Sustainable Rural Development Programme which, according to Everatt (2003:14) reflects the fact that the original strategy is no longer "merely a set of ideas but a set of implementable activities."

The future? Proposals for Rural SEED (Phase 2)

Members of the Rural SEED project team put in a proposal for a second phase of the project. Mr Bill Cowan describes the basic ideas for Phase 2:

The main ideas for Phase 2 were to carry on local work in one area, one district, in Alfred Nzo district in the Eastern Cape, and build on the successes so far, and make more progress in the technical aspects, things like reducing indoor pollution, disseminating better appliances, encouraging more efficient use of electricity, etc. And then take the lessons from that and communicate

those to other Energy Centres around the country, on the assumption that these programmes are going to continue. (Bill Cowan, interview)

However, at the time of the interview (February 2004), it was still unclear as to whether these programmes would, in fact, continue:

The two programmes are under review at the moment – one for Integrated Energy Centres and the other for solar electrification. So, again we're in a bit of a wait-and-see situation. (Bill Cowan, interview)

For Mr Cowan, this is not a bad thing, and he is certainly not eager for Phase 2 to go ahead immediately. He said that it would be better to wait and see what happens on the government side. However, this is not the only reason: changes in the EDRC as a whole concerned Mr Cowan too:

And then also EDRC was going through a transition at that time and we were losing quite a lot of staff, and I wasn't too confident about having a good basis in EDRC for another project of this nature and size. (Bill Cowan, interview)

According to Mr Cowan, discussions about Phase 2 will resume once the Completion Report has been distributed and processed.

3.4 The Rural SEED project team and other participants

In some respects, it is difficult to delineate the project team from the broader community of stakeholders, given the participatory and collaborative nature of this project. The main participants in Rural SEED (Phase 1) included:

- ◀ EDRC staff and associates: Mr Bill Cowan (Principal Research Officer)⁹ and Mr Monga Mehlwana led the projects in the Eastern Cape and Limpopo provinces, respectively. Others included Ms Gamieda Gierdien (Project Co-ordinator), Mr Patrick van Sleight (SEED Media Officer), and Mr Douglas Banks and Mr Justice Mavhungu, who were consulted at certain stages of the project. In general, the role of the EDRC staff was to organise the project, manage it, provide support services and logistics, provide technical advice, act as the information bridge between the local communities and national stakeholders, guide the emerging strategies and projects, negotiate with oil companies, and carry out the media and communications work.

⁹ Bill Cowan has two Masters degrees and has worked in research for twenty years. Mr Cowan has experience in the field of off-grid electrification in Southern Africa. His work has included technical, socio-economic and strategic aspects of off-grid electrification, the development of standards, regional Southern African liaison and renewable energy policy consultancy. His cross-disciplinary background combines social sciences and energy engineering, with previous experience as a sociologist and social researcher. He has been active in energy and development since 1986 and led EDRC's Remote Area Power Supply programme from 1990 to 1997. Mr Cowan was subsequently leader of the CAREDA programme (Cooperative Assistance for Rural Energy and Development in Africa) which focused on assisting improved rural energy service delivery, integration and feedback to rural energy strategy and policy development, and currently leads ERC's Energy, Poverty and Development group.

- ◀ Rural SEED Facilitators (who were also EDRC staff), Mr Boyce Plaatjies and Mr Thomas Phooko, who were located in the Eastern Cape and Limpopo provinces, respectively. These Facilitators provided the critical link with people in the pilot communities and provided a range of support, training and facilitation.
- ◀ A Danish Chief Technical Advisor, Dr René Karottki,¹⁰ was based at the EDRC for two years. His primary tasks included co-management of the project (with Mr Cowan), to contribute his Danish and international experience to the project design and implementation, to participate in communication activities, both at the community and the policy level, and to liaise with the Danish partners and donor.
- ◀ The EDA (Environmental Development Agency) Trust acted as a host organisation for the project in the pilot communities. The Rural SEED Facilitators were based at the EDA offices in Matatiele (Eastern Cape) and Polokwane (Limpopo). The EDA also assisted by introducing the project staff to local community members and organisations, and by providing guidance and supervision.
- ◀ Representatives of a few Danish non-governmental organisations – mainly OVE (Danish Organisation for Renewable Energy).

Throughout Phase I, a variety of other stakeholders participated in the project. These included:

- ◀ Rural community organisations – particularly energy committees, and later energy and development co-operatives – in the pilot districts where the project operated in Phase I.
- ◀ DANCED staff, based in Pretoria, provided support in relation to both the design and implementation of the project.
- ◀ A number of consultants and other professionals were sub-contracted to assist with specialised short-term tasks.
- ◀ Private sector companies provided financial and other support, including Eskom, the Paraffin Safety Association of South Africa (PASASA), the LPGas Safety Association of Southern Africa, and the South African National Energy Association (SANEA).
- ◀ The South African Department of Minerals and Energy, parliamentarians, Eskom, oil companies and other energy companies made valuable input. The project also engaged with organisations in Swaziland, Lesotho, Mozambique and Zimbabwe.
- ◀ Staff of the South African Institute for Distance Education (SAIDE) provided collaborative assistance in the development of the Rural Energy Resource Pack.
- ◀ BONESA assisted electrified household demonstrations in the Eastern Cape.

¹⁰ Dr Karottki is currently on an assignment with the Development Directorate of the European Commission in Brussels on the implementation of the European Union Energy Initiative (EUEI) that was launched at the World Summit on Sustainable Development in Johannesburg. EUEI focuses on improving access to energy for the poor, in support of the Millennium Development Goals and the Johannesburg Plan of Implementation. See www.euei.org for more details (René Karottki, e-mail, 31 August 2004).

3.5 Project funding

Primarily the Danish Co-operation funded the project for Environment and Development (DANCED). Phase I of the Rural SEED budget totalled R4,002,223. This did not include the services of Dr René Karottki, the Danish Technical Advisor who provided considerable support to the project.

Smaller financial inputs were also made by other organisations, for example (Cowan 2004:83):

- ⤷ The EDRC contributed funding in the form of facilities, expertise and staff hours
- ⤷ Eskom funded the EDRC to run a training course for the company's extension workers, and
- ⤷ The Department of Minerals and Energy and SASOL funded the development of a draft Rural Energy Information kit.

4 Modes and contexts of knowledge production and utilisation

The Rural SEED project (Phase I) is an example of a project where the context and mode of knowledge utilisation is deeply embedded in, and often indistinguishable from that of the knowledge production. It is also an example of a multiplicity of forms of uptake, application and implementation by a wide range of participants and stakeholders. And, like many other projects, it depended largely on the utilisation of prior knowledge and research information, as well as indigenous knowledge, in its conceptualisation, design and implementation.

If there is an explicit mode of knowledge production and utilisation in the Rural SEED project (Phase I), then it lies within the conceptual and practical framework of participatory action research. On the one hand, one of the primary assumptions and the *raison d'être* of a participatory approach is that participation by intended beneficiaries will ensure the relevance of the research and its utilisation. On the other hand, the 'action' in 'action research' implies the direct and immediate application of findings in the course of the project; in other words, using research outputs to inform the next action or development.

Because of the complex interweaving between knowledge production and utilisation in this project, it is difficult to keep these descriptively and analytically apart. These dimensions and dynamics are therefore discussed in one section. Some of the overarching features of the project process as a whole are firstly discussed, and specifically on what might be distinguished as the mode of knowledge production.

If one reads the narrative account of the Rural SEED project in the Completion Report, one might be forgiven for wondering exactly where the research is! For, rather than reading about the project under conventional headings such as "methodology", "data collection" and "results", one reads about workshops, demonstrations and awareness campaigns, or about the selection of local organisations, and the recruitment and training of facilitators. The reason for this is that Rural SEED is fundamentally an action research project, where emphasis is placed on both knowledge production and practical action.

The mode of knowledge production therefore has the following characteristics:

- ◁ It is highly participatory, consultative and collaborative
- ◁ It is based on a flexible and open-ended design, with very broadly stated aims and objectives
- ◁ It is a highly applied research project, given that the outcomes are directly intended to bring about social change within communities, and policy and practice change within local, provincial and national government, and among other role players in the energy sector
- ◁ More conventional forms of research are used in surveying community needs, and prior research and indigenous knowledge and information are drawn on throughout the project, and
- ◁ Information dissemination, knowledge transfer and capacity building are integral features of the methodology.

The project is interdisciplinary insofar as it brings together knowledge and skills in the engineering and social sciences. Finally, the project is intended to be “catalytic” – providing a baseline or ‘model’ of knowledge, practice and experience that could be implemented elsewhere. Some of these elements of the process of knowledge production are discussed in detail below.

4.1 The consultative, participatory and collaborative nature of the project process

The author specifically chose the three adjectives for the sub-heading above in order to signify three slightly different forms of engagement by Rural SEED project staff, pilot rural communities and other role players. ‘Consultative’ was used as referring to those instances in which project staff made enquiries of external stakeholders with regard to ideas or strategies for the project as a whole. ‘Participatory’ refers to the manner in which people from rural communities participated in generating knowledge about and analysing their energy needs and problems, and in developing action plans and organisational structures through which these issues could be addressed. ‘Collaborative’ refers to the manner in which many of the activities depended on a variety of inputs, such as the assistance provided by energy supply companies in the training workshops run for pilot communities. In reality, it is not always possible to tease these apart, since a single interaction can perform more than one function. Nevertheless, they do present a useful way of distinguishing these elements of the research (project) process. Further elaboration is provided below.

Broad consultation

Rural SEED staff consulted a wide range of stakeholders throughout the course of the project. This was particularly the case in the development of the project proposal, where EDRC staff consulted members of local, provincial and national governments, and national energy suppliers and associations. In the very early stages of the project, local rural project localities and local partner organisations were selected via a consultative investigation of local needs and opportunities. These consultations took place in both the Eastern Cape and Limpopo provinces with a range of potential stakeholders, including rural NGOs and

umbrella organisations; women's groups; community representatives (local informal leaders, development committee members, youth activists, etc.); traditional authorities (chiefs, headmen); members of parliament; local councillors; provincial government departments; development agencies; academic/research departments and consultants working in the field of rural development; energy companies and energy-related service companies; national utilities (Eskom, Telkom); and, the national Department of Minerals and Energy.

Collaboration

There were numerous examples of collaboration in Phase I. The collaborative nature of the project design phase, which brought the knowledge, skills and experience of the EDRC and Danish NGOs together have already been highlighted. There was also broad collaboration in the research components of the project. For example, the preliminary study of the status of existing rural energy initiatives, and the potential for improved integration of sustainable energy supply and use, was conducted in the pilot districts in the Eastern Cape. The main SEED participants in this case were Mr Douglas Banks, Mr Bill Cowan and Dr René Karottki. However, there were also a number of other people who collaborated on this component of the project, namely three other EDRC staff members (Mr Lwazikazi Tyani, Ms Nthabi Mohlakoana and Ms Bronwyn James); staff from the EDA, the Independent Development Trust, Eskom, the Departments of Health, Education and Agriculture, and Telkom; community groups and local government; and, an academic unit at the University of the Western Cape¹¹. Other forms of collaboration included the work with the South African Institute of Distance Education (SAIDE) in the development of the **Rural Energy Guides**, and collaboration with companies, such as Eskom, in the provision of training.

Participation

In the broader sense, Rural SEED is a participatory project in that a wide range of stakeholders, other than the research or project team, participated in various aspects of the project. For example, people from local communities and local government structures participated in workshops and awareness campaigns, elections, and local government planning. In addition, other types of participation were facilitated by Rural SEED staff, such as visits to pilot communities by the Minister of Minerals and Energy, and by Eskom staff, or discussions between companies and the local participants. In the narrower sense, the research was participatory in that community members were the primary actors in the formulation and undertaking of local projects, as well as in the collection and analysis of local-level data to inform the development of action plans.

As mentioned earlier, quite often interaction and engagement among stakeholders reflected all three elements. This was no more evident than in the development of the project proposal and design, which is explored in detail in the next section.

¹¹ PLAAS - the Programme for Land and Agrarian Studies.

Participation, collaboration and consultation in setting the research agenda and designing the project

The conceptualisation and development of the project proposal and design was undertaken collaboratively and, to a large extent, was informed by the considerable prior experience in rural energy issues and initiatives on the part of Mr Cowan and other EDRC staff, as well as the Danish NGOs with whom the EDRC collaborated:

[The project design] was based on EDRC experiences of working with South African rural energy/development programmes and policies, and predictions about what could be useful in coming years. It also brought in insights from Danish experience, both from Denmark itself and from Danish co-operation with other developing countries. The Danish contributions included a heightened awareness of international post-Rio sustainable development agendas, as well as the Danish historical experience of uplifting their former rural society through co-operatives, community education, etc. (Cowan 2004:7)

The slightly different agendas or emphases between the EDRC, on the one hand, and DANCED and the Danish NGOs, on the other, did produce some tensions that needed to be ironed out. In particular, while the Danish representatives had a clear environmental agenda, the EDRC was more focused on the 'people issues':

There've been some, I wouldn't say conflicts, even tensions is maybe a bit strong, between our views on sustainable development and those of, for example, DANCED and Organization for Renewable Energy, because we would tend to put issues like equity, poverty alleviation, sustainable livelihoods, we would tend to put those first, whereas more environmentalist organisations tend to put things like renewable energy first. (Bill Cowan, interview)

Despite this issue, it appears that there was limited 'interference' by the funding organisation (DANCED) in the project design process.

In formulating the proposal, and later the project design, the collaborators consulted very widely with people from government (national and local levels), energy suppliers, etc.

Although rural communities were to become the core focus of the Rural SEED project, and participate actively in the development of local action plans, these communities were not directly involved in formulating the proposal or the project design, as is the case in other projects with a participatory design. However, as Mr Cowan pointed out, his ideas for the proposal were directly rooted in his and other EDRC staff's experiences and interactions in rural communities around energy issues. In this way, people in these communities had made an indirect contribution of their indigenous knowledge to the project design.

Nevertheless, Mr Cowan described his anxiety about not having directly consulted the pilot communities as follows:

I was working in rural communities and discussing these issues, for example, with a network of school teachers in the Eastern Cape. But, at the same

time as we were designing the project, which took months and months, even years, I remember that feeling of deep anxiety about whether what we were saying would actually be real for people in rural communities. And it was a huge relief when we actually started and, we didn't really say what the project was about, but we started holding workshops with people, saying if you had the opportunity of working with the project, it's to do with energy, what sort of things would you like us to do? And there was great enthusiasm. And also what people spontaneously said they would like was exactly, just about exactly what we'd designed. We designed it in a very open-ended way. (Bill Cowan, interview)

The ideas for the proposal were also the result of work that Mr Cowan and others had done with government officials, often in the context of research commissioned by government or by other organisations, such as the Independent Development Trust. Mr Cowan commented, "it was being in a position between the two that was so important to the formulation of the proposal."

Despite the challenges, Mr Cowan argued that the broad consultation and collaboration in conceptualising and designing the project played an important role in the projects' future successes:

A strength of Rural SEED is that, to a large extent, it was initiated, designed and carried out by people who had good connections and foresight into South/Southern African developments. In this way there was a higher chance that guesses about future conditions, and what kinds of project contributions would be relevant to those conditions, would turn out to be valid. (Cowan 2004:42)

4.2 The flexible project design

Since the Rural SEED project was conceived as an action research project, the original project design was very open-ended and flexible, outlining only the broad objectives to be achieved, and the strategies that would be followed. In the spirit of action research, the idea was that the specifics of the project would take shape in response to the actual needs and opportunities of the pilot communities, as these were identified, rather than imposing a prior agenda.

According to Mr Cowan, this original design proved to be very robust and successful in achieving its broad aims. The open-endedness of the design did, however, pose some problems in terms of persuading the funders of its importance, and in terms of reporting on and evaluating the project process and outcomes:

[The funders] were a little bit resistant or critical about the lack of definition, but I think they also understood quite well that it's important not to impose an agenda in this kind of participatory rural development project. It turned out to be quite a problem in writing progress reports and things like this Completion Report, because so much of the project was process-oriented. It's much easier to write about it if you have some output like building a dam. And if instead some of the most important

outputs are two hundred community workshops, you know, how do you evaluate that? (Bill Cowan, interview)

4.3 Characteristics of the research dimension

The more 'conventional' forms of research

As alluded to in the introduction to this section, the more conventional forms of research are not always clear in this project. In fact, when Mr Cowan was asked, – “where is the research?” – he said: “Yeah. Well, I’m tempted to give the short answer, but it would be misleading. The short answer would be to say it’s not a research project.” The reason this answer is misleading is that although the research aspects of Rural SEED are not foregrounded in either the project or the final report, they were nevertheless critical inputs into the overall progression of the project. Largely, the research took the form of needs and situational analyses amongst both local and national stakeholders. For Mr Cowan, however, the most valuable data collection and analysis took place in the interactions with participants. The following quote also illustrates how the research components were deeply embedded in the development actions:

To give you just an example, I learnt much more about rural energy during this project than I have in ten years before. We had some sort of formal, conventional research, both along the lines of interviewing a wide range of people to find out the institutional situations, and energy supply opportunities, etc etc. Other bits would have been conventional house-to-house surveys using questionnaires, finding out about energy use, needs, etc. I’ve kind of pushed all that into the background, in writing about the project, because the more kind of lively and real information has come out of the participative processes, the workshops, where community people have sat down and analysed – they’ve done the research themselves. In some cases they’ve done their own surveys, a few of them would go around all the houses asking questions. But it’s mainly in those workshop situations where people gather together the problems and then start building up problem trees, saying “What causes this? What can we do about it? Who’s involved? What more information do we need?” And our role in the project would be to help facilitate that process. (Bill Cowan, interview)

Prior research and indigenous knowledge

Embedded in the project narrative in Section 3 was the ongoing and important role of prior research knowledge on the part of the project leaders and other academics, and the indigenous knowledge of the rural community members who participated.

[] in terms of knowledge, you’re relying 95% on the knowledge that the local people have, which is incredibly rich and thorough. And then there’s a complementary process where there’s a whole lot of knowledge they don’t have, usually information from the supply side, and then we would bring in people from Eskom, the government, from solar energy companies, oil companies, etc, to explain their side of the picture. And then there would be more community workshops to discuss that, absorb it, work out strategies, and so on. We also had a, particularly myself, we had a role as a research organisation where we’ve picked up a lot of

knowledge from our other projects. So we could then convey that to people and tell them what electrification strategies were, how they were changing, what the benefits and limitations of solar electrification are, all that kind of thing. (Bill Cowan, interview)

The indigenous knowledge of the rural people in the pilot communities formed a significant part of the knowledge resources of the Rural SEED project. As Dr Karottki commented: “The knowledge of the community regarding their own problems/ resources, local political issues etc played a crucial role” (René Karottki, e-mail). Community members were given the opportunity to provide information on their current practices (which often include a combination of traditional cultural energy practices, such as the use of cow dung as a fuel, and more modern fuels such as liquid petroleum gas which is distributed and sold by petroleum companies, amongst others), and highlight their problems and ideas for solutions.

Mr Plaatjies provided an example of how the indigenous knowledge of community members was captured and then fed into further developments within Rural SEED; namely, the community’s input and response to DANCED’s funding proposal in relation to energy supplies, and particularly the introduction of renewable, environmentally-friendly energy sources.

The communities were arguing that, at the moment, as the communities, we are trapped in using paraffin, and it is of no use that whilst we are using this paraffin, you tell us you are going to bring in the solar cookers and all these renewable energies, whilst, first of all, we won’t afford them financially, in terms of buying them. And you rather start with what we are currently using and make it more affordable and accessible to us. And then gradually shift us to a more appropriate type of energy that we can use, that is more environmentally-friendly. (Boyce Plaatjies, interview)

Mr Boyce Plaatjies also observed that some of the indigenous energy practices still employed by rural communities, such as the cow dung mentioned earlier, are regarded by environmental agencies internationally as ‘renewable energy’ sources, but that communities are not aware of this, or organised around renewable energy approaches:

In terms of the cow dung that they’ve been using. For instance, people would, if you go to them, like for instance the renewable energy, first of all, that’s one of the things that they’ve been using and not being aware in terms of they are actually utilising renewable energy, like for instance, in terms of fruit-drying, all those things, it’s just that they were not that organised. So those were the things that we could pick up that they are aware about these things, but not to an extent that they could pronounce them. (Boyce Plaatjies, interview)

4.4 Research and information outputs

Phase I of the Rural SEED project generated a wide range and number of outputs that were disseminated to target audiences in a variety of ways. Given the participatory action research approach to the project, many of these outputs played an integral role in the unfolding of the project. In other words, outputs were produced which formed the basis

of, or informed further developments in the project. For example, the results of various mini-surveys and needs analyses were written up for use by project staff in the ongoing implementation of the project. In addition, local actions plans were developed within each pilot community, primarily by community members and assisted by the Rural SEED Facilitators. These outputs are therefore closely linked to both the modes of knowledge production and utilisation.

The project also generated information products, based on prior and current research, and experience working with rural energy issues and stakeholders that are targeted at energy activists, development workers, policy-makers and others in the energy sector, and these are described in detail below. Except for Mr Monga Mehlwana, who based his PhD research on the Rural SEED, there have been no other 'conventional' academic outputs, such as articles in peer-reviewed journals.

Only a small minority of the main local "audience" for the kinds of community-based developments piloted in the Rural SEED project have access to academic journals. There is certainly also an international interest in the developments and approaches, but I feel the success and sustainability have not been sufficiently evaluated yet. Evaluations by the DME are still in process. (Bill Cowan, e-mail)

A range of different strategies for disseminating information to local communities, government and the energy sector were employed, and these are discussed in Section 4.5. The following are some of the primary information products to emerge during Phase I.

The Rural Energy Resource Pack

In the original project design it was proposed that one of the activities would be to produce a 'rural energy options handbook' for use by the Rural SEED Facilitators and other development workers. The South African Institute for Distance Education collaborated in the development of these materials, trialling and piloting the early drafts. Once this was done, and a greater demand for resource materials of this kind became apparent, the idea of a 'handbook' was reframed as a multi-media 'resource pack', and the Rural Energy Resource Pack was developed. The Pack contained a CD and three booklets that included:

- ◀ The experiences of local communities in forming energy committees, co-operatives, energy centres, etc
- ◀ Methods used to workshop and survey local energy need and opportunities, liaise with national service-providers, form local action plans, etc, and
- ◀ Rural electrification in South Africa (with some technical background to help people understand rural electrification programmes and policies).

The Rural Energy Information Kit

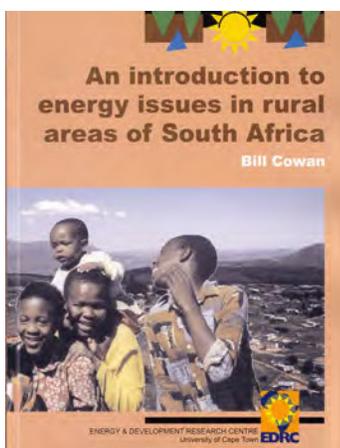
In 2002, the Department of Minerals and Energy put in an urgent request for training and information materials for their "Train the Trainers" programme, and approached EDRC to draw up a proposal for this. The proposal offered to supply the existing SEED materials (with some editing) as well as new materials prepared by EDRC, and assemble collected

materials from a number of other sources. SASOL provided funding support and expert coordination assistance.

The Rural Energy Guides

At the end of Phase I, the Danish Embassy approved a Rural SEED proposal to use the remaining project funds to bring the materials to publication status (originally a DANCED suggestion). Three such guides¹² were compiled and are targeted at activists and development workers in communities, local government, businesses or NGOs who are involved in rural energy issues.

One of the Rural Energy Guides



The contract report

The Completion Report (Cowan 2004) provides a detailed overview of the Rural SEED project (Phase I), including an assessment of the impact of the project at the local community level, and at the local, provincial and national government levels.

4.5 Communication and dissemination strategies

The SEED Programme as a whole, and hence the Rural SEED project, adopted a range of methods to communicate and disseminate information to stakeholders. Mr Bill Cowan described the rationale behind this as follows:

Part of the reason for having this big stress here on communication products, like newsletters, web sites, policy briefs, promoting mass media coverage, a lot of that was given emphasis by the Danes, by the Danish NGO experience. And in fact, I think they were more, in particular the person who worked with us, René Karottki, he'd been the kind of activist who makes friends with people in parliament, talks to them over coffee in the evening, and so on. And he was very sensitive to the beneficial

¹² The three titles include: **An introduction to energy issues in rural areas of South Africa**, by Bill Cowan; **Taking action to solve local energy problems**, by Patrick van Slight, Ilne-Mari Hofmeyr & Boyce Platjies; and, **Understanding electricity and rural electrification in South Africa**, by Bill Cowan.

opportunities of engaging, of making a link between local work and policy-makers on the one hand, and the general public on the other. So that's part of the reason why these communication products were stressed so much. (Bill Cowan, interview)

These methods of communication and dissemination are summarised in the Completion Report as follows (Cowan 2004:23-26).

Newsletter

Distribution of a quarterly newsletter entitled **SEED Update** that contained news and articles pertaining to both the Urban and Rural SEED projects. The newsletter was distributed to local communities served by SEED, members of local government, energy companies and agencies, NGOs, parliamentarians and government. It was also distributed internationally to organisations interested in energy and sustainable development.

Popular media

From time to time, topical articles were written for journals and magazines, and SEED Programme staff engaged with journalists and filmmakers in the making of documentaries about, for example, solar electrification or renewable energy sources. By early 2004, around twenty articles were published in popular journals.

Presentations

Regular presentations were made to policy-makers and other target groups, e.g. Parliamentary Portfolio Committees for Minerals and Energy, and for Environment and Tourism; as well as conferences and seminars. These were important communication strategies adopted by Rural SEED, which emphasised

- i) helping local people communicate their experience and their opinions and
- ii) setting up dialogue situations to bring national actors (parliamentarians, government staff, energy suppliers, etc) into closer communication with rural community representatives.

Five presentations were made to academic peers; twenty presentations to non-academic audiences; and, three presentations were made to expert committees / panels.

Policy briefs

Rural SEED staff produced a number of policy briefs on key issues requiring political or strategic attention, arising from experience of the rural project activities and from consultations with the decision-makers. The idea for policy briefs as an output from the project came mainly from Danish contributors. Danish experience of working between civic, NGO and government agencies helped to make Rural SEED of greater national relevance by fostering contacts with national decision-makers and planners. These briefs were often accompanied by presentations to, for example, parliamentarians, the Department of Minerals and Energy, and rural electrification planners.

Examples of these policy briefs include:

- ⤿ A short analysis of the potential for rural mini-grids (including local grids based on renewable-energy hybrid systems), requested on behalf of the Minister of Minerals and Energy.
- ⤿ The parliamentary portfolio committees for Minerals and Energy, and for Environment and Tourism, were briefed on local action on energy and integrated development taking place in communities where SEED was working.
- ⤿ Dr René Karottki prepared a very short description of the shape and potential functions of community-managed Rural Energy Centres, based on SEED community discussions and experiences.
- ⤿ Mr Bill Cowan presented ideas for changing rural electrification funding mechanisms, in order to gain greater integrated development benefits, to parliamentarians, DME and Eskom planners.

Video footage

Community members producing video footage



Source: Cowan 2003:15

The SEED project also made extensive use of video. The most important use of video footage was to capture the voices of local people explaining and describing their conditions and needs, which was then used to make presentations to, for example, Eskom, government and NGOs in Swaziland and Lesotho, and for training purposes. Video clips were also built into a CD version of the trial Rural Energy Information Pack. People from the local communities commented that the video enabled them to judge the speakers better, and to see that they were “telling the truth”. A large part of the attraction, too, was seeing local people on screen:

It would be these people speaking about the issues, analysing them, saying what energy needs they have [], and saying what they plan to do about it, how they were setting up committees within their development forums, and how they were collecting money to do this and that. And then addressing

government and saying, you know, we would like to work in partnership with you, and if we can get things going well in our area – it’s not just for this area – we can give an example for the whole of the country. Now that was all recorded on video and then presented at a conference, a World Bank, Department of Minerals and Energy conference. And it was so powerful to people like the Minister. (Bill Cowan, interview)

Website

The SEED Programme set up a website entitled **SEEDLinks**. However, according to the report, the website was not as successful as other forms of communication.

4.6 Features of the mode and context of knowledge utilisation

In a project as multifaceted, far-reaching and participatory as the Rural SEED project, it is not surprising that many opportunities for utilisation, among a wide range of stakeholders, were created throughout the course of Phase I. By way of example, one of the initial outputs of the Rural SEED project was a preliminary study of the status of existing rural energy initiatives, and the potential for improved integration of sustainable energy supply and use, in the pilot districts in the Eastern Cape. While the primary purpose of this survey was to inform the next stage in the project, the report was also utilised by a range of other stakeholders. The range of users, and the ways in which they utilised the findings of this survey, are shown in the table below (adapted from Cowan 2004:48):

Users	Way in which the findings were utilised
Participants at a stakeholders' workshop in Matatiele	As a basis for discussing needs, opportunities, priorities and the relevance of the Rural SEED project in the area
EDA Trust	Overview and highlighting of energy-related issues, relevant to EDA's local development work
DME staff	Preparatory background for later DME visits to the Maluti / Mt Fletcher areas
Some Eskom regional staff	Overview of local issues, especially relating to schools electrification and grid / non-grid electrification issues
German Development Bank consultants	As above, in relation to the design of another solar electrification project within the "Concessions" programme – probably in Eastern Cape
Postgraduate students from (mainly) African countries	Material used in their project work on rural energy and development options
Rural SEED Facilitators	Once employed, the report provided useful background for their induction, training and first stages of work in the SEED localities

The table highlights a variety of types of use, including informing action and practice, improving understanding, planning for future projects, and for postgraduate training. The table is also an indication of the project leader's awareness of knowledge transfer and utilisation issues in the context of the Rural SEED project. The Completion Report

reflects on a range of such issues, such as, the potential impact of the policy briefs and the utilisation of embodied knowledge via employment in energy sector. The project leader's "preliminary assessment of the main impacts of Rural SEED", reproduced in Box 3, points to the perceived outcomes of the project, which translate very closely into perceived 'uses'.

Box 3: Preliminary assessment of the main impacts of Rural SEED (Phase I) in the Completion Report

- Increased understanding of rural energy and development priorities in South Africa
- Increased appreciation of the scope for local action and organisation in rural communities, around energy and development issues
- Capacity-building support in these areas
- Methods for better communications and joint planning – between local communities, local government, and supply-side planners, service-providers and policy-makers
- Policy support and influence, around integrated sustainable rural development and local empowerment
- Local energy committees, energy-development co-operatives and Integrated Energy Centres
- Popularisation of the approaches developed in Rural SEED, and
- Improved energy services and energy-development integration for low-income communities in South Africa.

Source: Cowan (2004:85)

In general, there are four main forms of knowledge utilisation associated with the first phase of Rural SEED; namely, knowledge transfer via the 'information bridge' activities, capacity building etc; practical developments in the pilot rural communities; the adoption of the co-operative energy centre 'model' by the national Department of Minerals & Energy; and, providing an information base for energy activists. Examples of these different kinds of utilisation are described in detail below.

4.7 Strategies, agents and examples of knowledge transfer

Within the context of the Rural SEED project, two specific strategies for knowledge transfer and utilisation were adopted: the first was the role of Rural SEED staff as an 'information bridge' between rural communities and other role players in the energy sector; the second was the use of workshops, demonstrations and other methods to build the capacity of local and national actors. The intended beneficiaries included rural energy users and community organisations, national and local government, and energy suppliers. These two knowledge transfer strategies are discussed in brief below.

The 'information bridge': Effecting better communication, information-sharing and uptake

The idea for the SEED Programme office and the Rural SEED Facilitators to establish themselves as a virtual information bridge was integral to the design of the project. The information bridge is effectively "a two-way conduit for communications between local actors in the project areas (community groups, RSFs, NGOs and local authorities) and

provincial and national role players (government officials, MPs, energy companies, etc.)” (Cowan 2004:60).

In line with the aim of bridging the information gap between nationwide supply initiatives¹³ and local “demand conditions”, the Rural SEED project facilitated consultation and information-sharing between a wide range of energy suppliers, planners and policy-makers, on the one hand, and local communities and groups, on the other. The Completion Report (Cowan 2004:14-15) provides a long list of examples of the kinds of information conveyed to local communities during these consultations. Examples include Eskom staff explaining electrification plans for local areas, and liaising with local authorities and organisations around electrification plans; and oil company representatives who were requested to help set up local liquid fuel outlets.

The Completion Report (Cowan 2004:60) identifies the major groupings with which Rural SEED staff interacted:

- ◀ **National government**
Staff at the Department of Minerals & Energy was informed regularly about developments in the pilot areas. In return they provided information about government policies and programmes. Similarly, the Minister and Deputy Minister of Minerals & Energy were briefed from time to time. The Minister in particular provided guidance on how Rural SEED and participating communities could work in harmony with the government's Integrated Sustainable Rural Development objectives. Other national government departments consulted included Water Affairs & Forestry, Education, and Environmental Affairs & Tourism. Members of parliament were informed of project developments, and several provided advice and assistance.
- ◀ **Provincial government**
Communications between project communities and provincial government officials took place in the Eastern Cape and Limpopo provinces. Departments consulted included Public Works, Agriculture, Health, Land Affairs, Welfare, Finance, Tourism and Youth, and officials in the Premiers' offices.
- ◀ **Companies and other agencies, in connection with solar non-grid “concessions”**
With SEED facilitation, concessionaire company staff provided information about solar electrification and rural energy stores to all the project communities, and to local government, local development forums, etc. Further information on concession plans was communicated from DME, the National Electricity Regulator and Eskom. Several concession companies, other solar energy companies, and local and international consultants, approached SEED for information about local conditions, attitudes towards solar electrification, and so on.
- ◀ **Other renewable energy matters**
These included advising companies and consultants, embassies, churches, donors, charities, local and international research organisations, and so on, about proposed

¹³ Nationwide supply initiatives include, for example, Eskom, companies involved in solar electrification, oil companies, government departments, and niche entrepreneurs, such as those which promote improved woodstoves or solar cookers.

wind energy, micro-hydro, fuel cell, ethanol gel fuel and solar thermal applications (water heating, solar cookers), and providing information to community groups on solar pumping, solar and biomass cookers, and thermally efficient building design.

Electrification planning (grid)

Two-way communications were established between local groups (development forums, local government, energy committees and co-operatives, etc.) and grid electrification planners (from Eskom and also DME).

Health, safety and efficiency issues around energy use

Links were made between energy safety associations, such as PASASA (paraffin) and LPGSASA (LPGas), and local community groups; similarly, around efficiency issues, with ElektroWise (efficient use of electricity) and BONESA (demonstrations and dissemination of energy-efficient lights).

Liquid fuels

Discussions were held with several oil companies, some of which provided advice, assistance and community training. SEED staff briefed some of the companies about energy centre developments and alternative rural distribution routes for fuels like paraffin and LPGas.

According to Cowan (2004:60), while some of these contacts and interactions were more useful than others, overall, the information bridge “made a valuable contribution to ‘reducing the distance’ between local people’s concerns and the many agencies and individuals who work to help rural energy and sustainable development.” In addition, the contacts made formed the basis for further initiatives on the part of local community groups, and government officials and energy suppliers:

In the latter stages of Phase 1, community groups such as the Caba-Mdeni Co-operative were directly taking the initiative in contacting energy suppliers, government departments (national and provincial) and even the President. Similarly, both government officials and energy companies/associations were directly contacting such community groups, indicating that valuable working relationships had been established. (Cowan 2004:61)

It appears that one of the most effective vehicles in this regard was the use of video footage to convey the concerns and requests of rural communities to policy-makers in national government:

This appeared to convey strong messages to the national and international conference participants, backed up by the Minister of Minerals and Energy (sitting in a front seat and regularly addressing the auditorium about the content of such presentations, and government’s strategy directions). SEED project staff were very happy to have helped local rural community activists and householders express their powerful messages to this kind of audience – many of whom work with rural energy issues but lack direct exposure to rural energy conditions and local action paths. (Cowan 2004:69)

Capacity-building in local communities and the energy sector

A core feature and primary objective of the Rural SEED project was to build the capacity of local rural communities, and of local and national government, energy suppliers and

other role players in the energy sector, around renewable energy sources and integrated energy and development. The role of the Rural SEED project team as an information bridge formed part of their capacity-building endeavours. More directly, however, Rural SEED engaged in building the capacity of stakeholders via targeted workshops, seminars and training courses, as well as demonstrations. (See the Appendix for the list of capacity building activities in the Completion Report.) Some of these capacity-building activities are described in brief below.

◀ Training workshops

Approximately 100 training workshops were held. Much of the training was undertaken in collaboration with others, such as Eskom, PASASA and LPGas, and focused on the use of different fuels and on safety issues. A three-day rural energy, environment and development course was prepared and conducted for NGO, CBO and government extension staff.

◀ Energy use seminars

Two local level sustainable energy use seminars were carried out: the first was an awareness seminar in the first part of the project, and the second, a concluding seminar in the last part of the project for dissemination and discussion of the experiences learnt. The Rural SEED Facilitators, Cape Town SEED staff and the EDA, ran these with contributions from energy and development practitioners. They encouraged local participation, and provided information about local needs, energy supply options and the plans of energy service providers (Eskom, government, private companies, etc).

◀ Demonstrations

Mr Cowan described the focus of the demonstrations as follows:

Demonstrations included energy-efficiency improvements in low-cost building design, solar stoves, improved (commercial) wood stoves, solar electrical equipment (solar home systems, and PV pumping in Limpopo) and piloting of energy-efficient compact fluorescent lights among 1800 households in four villages in the Magadla area (with BONESA). (Cowan 2004:55)

◀ Personnel exchange

Ten younger South African professionals (two of whom were the Rural SEED Facilitators) received training in Denmark through 2-week exchange internships with e.g. OVE, DIB and Danish Energy and Environment Offices.

◀ Regional workshops were conducted in Lesotho and Swaziland

to share and discuss programme experiences, to discuss further programme phases and to identify opportunities for future regional co-operation.

Subsequent employment in the energy sector

The two Rural SEED Facilitators and the project co-ordinator in the Limpopo province (Mr Monga Mehlwana) have taken up employment in the energy sector, or related energy fields, since the end of Rural SEED (Phase 1). These are important forms of knowledge transfer, especially since these individuals have stayed within the energy sector. Mr Boyce Plaatjies, for example, was recruited by the Department of Minerals & Energy as their Chief Energy Officer the month after he completed the Rural SEED project (i.e. in

May 2002). In this position, Mr Plaatjies is responsible for setting up the Integrated Energy Centres (IECs) as part of the DME's programme (see Section 4.9 below). According to Boyce Plaatjies, they have drawn on the methodology and approach of Rural SEED in establishing the IECs in new areas and, clearly, Mr Plaatjies' knowledge, experience and contacts in this regard is invaluable.

Mr Thomas Phooko (Rural SEED Facilitator in the Limpopo province) was also recruited by the DME after his stint on the Rural SEED project, and Mr Mongameli Mehlwana (project co-ordinator in Limpopo) is now employed in the CSIR's Environmentek division.

Feeding into postgraduate training and degree programmes

Finally, the Rural SEED project fits very closely with the Energy, Poverty and Development research programme of the ERC and has fed into the Masters programme. According to Mr Bill Cowan,

The knowledge that we were gaining, both about issues and policy matters were of great interest to the people in that programme. They have also been of great interest to people from other countries, who take part in training courses here and have certainly fed strongly into the Masters programme.
(Bill Cowan, interview)

Mr Monga Mehlwana, co-ordinator of Rural SEED in the Limpopo province, has been undertaking case studies on the Rural SEED project towards his PhD degree.

4.8 The rural poor as users: Practical developments in the pilot communities

In Section 3.3, a brief overview of the stages in the evolution of Phase I of the Rural SEED project is provided. Implicit in much of that narrative was a number of examples of how the findings of needs analyses, workshops, information dissemination and consultation were used to inform further developments in the pilot communities. These included, amongst others, the development of local action plans, and the adoption of the approach of 'co-operative energy centres'.

As indicated at the end of Section 3.3, the Rural SEED activities unfolded differently in each of the pilot communities. It appears that in Magadla village in the Eastern Cape, community action progressed relatively rapidly and effectively, and resulted in the establishment of one of the most successful co-operatives – the Caba-Mdeni Energy Development Co-operative – in the Rural SEED project:

In Magadla, community members built energy centre premises, negotiated and established cheaper bulk supplies of paraffin and LPGas, conduct awareness and safety campaigns, demonstrate improved appliances, and the Co-op supports income-generating projects as well as employing a number of community members (from poorest families) in its operations. Additional product-lines and services are being added over time (e.g. diesel sales and a wider range of appliances and fuels). An evaluation of energy centres by DME has credited the Caba-Mdeni Energy Development Co-operative as a role-model for other initiatives, and they have now been offered further

*assistance by DME and SASOL to consolidate and expand their operations.
(Cowan 2004:55)*

In fact, the Caba-Mdeni Energy Development Co-operative has been adopted as a “role-model for other initiatives” by the Department of Minerals and Energy. This is discussed in detail in Section 4.9.

By contrast, developments in other areas have proceeded at a snail’s pace and, in some cases, not at all. The Completion Report describes the situation in early 2004 as follows:

Communities in the Bochum and Ngwaabe have plans, but have not proceeded to implement these plans, and are mainly waiting for further promised government assistance, perhaps in the second phase of government’s “roll-out” of Integrated Energy Centres. Ngwaabe was originally scheduled for first-phase government assistance, but this was changed. In Mvenyane, draft plans for establishing an energy centre (and associated activities) seem to be unresolved, mainly as a result of contested development leadership in the area. (Cowan 2004:55)

The Caba-Mdeni Energy Development Co-operative in the Eastern Cape



Source: Van Sleight, Hofmeyr & Platjies 2003 (cover photograph)

Mr Cowan described some of the reasons why developments in the Ngwaabe district in the Limpopo province ground to a halt after the Rural SEED project ended:

A recent letter from the Ngwaabe Co-operative describes them as having fallen into a “black hole of darkness” after the SEED facilitation was withdrawn. Part of the problem was the promise that the government

together with an oil company would take over further developments towards an Integrated Energy Centre in Ngwaabe. Another problem was a decision by SEED not to go further with business plan development for the Ngwaabe Co-op, both because of the government promised intervention and also because survey data supplied by the Co-op for business plan development appeared to have been made up. (Cowan 2004:52)

The ways in which these experiences and outcomes had an impact on policies and initiatives at the national government level are considered in the next sub-section.

4.9 Impact at the national government level

The DME and Integrated Energy Centres (IeCs)

According to Mr Bill Cowan, probably the most 'successful' outcome of the Rural SEED project (Phase 1) was the influence the project had at the national government level. In particular, the concept of *integrated* Energy Centres at the local level has been taken up as an integral feature of the Integrated Sustainable Rural Development Strategy. Interestingly, Bill Cowan traces this development to a short policy brief, prepared by Dr René Karottki, (see Section 4.4), that was disseminated quite widely, and which became a working document for the DME's initiative to establish Integrated Energy Centres around the country, as part of its contribution to the ISRDS. In the following quote, Mr Cowan describes the snowball manner in which this notion grew within government circles, in terms of a metaphor of a paper boat sailing down a river towards the sea:

I can't remember if it was one page or two pages – a very, very short and simple and to-the-point document written by the Danish technical advisor who was working with us, describing how an Energy Centre can work, with a commercial side selling fuels and appliances and a non-commercial side helping to raise awareness, addressing environmental issues, safety campaigns and so on. [] And that's been probably the most influential document out of the whole project, and it's been like a ... imagine if you had a boat made out of paper and you throw it into the stream, it gets stuck for a bit and it runs through the reeds. Eventually, a year later you find it somewhere near the sea. That's what this document was like. It found it's way into being the cornerstone of, according to some people in government, the cornerstone of the Integrated Sustainable Rural Development Strategy. And this idea of Integrated Energy Centres was put forward as the main strategy at the Johannesburg [World Summit on Sustainable Development]. (Bill Cowan, interview)

In this sense, the DME has adopted the idea of Integrated Energy Centres as a “model” or “best practice” which can be transferred to other areas (an idea and objective of the Rural SEED project, reflected in the notion of ‘pilot implementation’). In particular, the Caba-Mdeni Energy Development Co-operative in the Magadla district of the Eastern Cape appears to have been taken up enthusiastically by government and other players in the energy sector:

The Caba-Mdeni Energy Development Co-operative has attracted particular attention from government (national, local and provincial), private sector companies, parastatals, and industry associations concerned with rural development and/or improved rural services. The local “Energy Centre” concept as piloted in the Rural SEED project has been quoted by the government as a test example for going ahead with a larger government-assisted rollout of “Integrated Energy Centres” in South Africa. This government strategy (including public-private-community partnerships in establishing Integrated Energy Centres) now forms one of the cornerstones of South Africa’s Integrated Sustainable Rural Development Programme. (Cowan 2004:20)

Boxes 4 and 5 highlight some of the developments around Integrated Energy Centres up until August 2004.

Box 4: Extract from the Budget Vote Speech by the Minister of Minerals & Energy, Phumzile Mlambo-Ngcuka, 22 June 2004

Integrated Energy Centres and Poverty

The new model for retailing of [paraffin and LPGas] forms a good backbone for the creation of sustainable leCs. As the President enjoined us to promote cooperatives, we have already started in the creation of viable cooperatives. Creation of these will facilitate job creation in the poorest of our people; help improve access to modern energy carriers by the poor; educating the poor about energy uses and to use energy efficiently to lower the cost to the households and lead to a better understanding of energy economics by the poor. leCs will not only make communities consumers of energy products but owners of their own energy businesses. [] It is envisaged that the review of leCs will be completed by the end of August 2004. A minimum of 7 leCs will be launched in this financial year. These will be in KZN, Eastern Cape, Northern Cape, North West and Mpumalanga.

Source: <http://www.pmg.org.za/briefings/040622mineral.htm>

Box 5: Sasol injects R15 million into rural energy for the poor

Sasol is investing R15 million in a project to help Government set up ten Integrated Energy Centres (IeCs) over the next three years to make energy more accessible and affordable to the rural poor of South Africa.

The envisaged Integrated Energy Centres will be located as centrally as possible to specific communities and surrounding villages and it is intended to exclude as many middle men in the distribution value chain as possible.

Sasol chief executive, Mr Pieter Cox, says: "Instead of wholesalers, distributors, routers and spaza shop involvement, energy products will be delivered directly to the Integrated Energy Centre that will become sole wholesaler and distributor. Feasibility studies are currently underway to determine the best suited products which could range from liquid petroleum gas (LPG), paraffin, electricity and solar energy to coal."

The IeC concept stems from President Thabo Mbeki's Integrated Sustainable Rural Development Strategy (ISRDS), which is presently being implemented by the South African Government. It aims to assist the rural poor by coordinating service delivery and providing infrastructure.

The Department of Minerals and Energy (DME) regards energy as the prime catalyst for socio-economic development and has identified IeCs as prime growth drivers for capacity building within poor communities. []

Source: <http://www.sasol.com/>

While the government has used the term "best practice" in relation to the Energy Centres, Mr Bill Cowan is more hesitant about the replicability of community initiatives such as the Caba-Mdeni Energy Development Co-operative:

The DME did a review. They've set up two Integrated Energy Centres so far. They did an internal review of those two plus SEED, and came to the conclusion that the SEED model represented a best practice, mainly because that energy co-op was both commercially viable and also was attending to non-commercial development issues, whereas the others were more like the energy supply centres. So, yes there is an interest in best practices. It's just rural development is so difficult and best practices are really hard to follow. (Bill Cowan, interview)

Despite these apparent successes, however, Mr Cowan is very hasty to point out that since the Rural SEED project is one of a number of movements or initiatives around sustainable energy in South Africa, it is possible to overstate the impact of this particular project in certain cases:

You've got to be very careful about how to interpret all that because it's easy for me to make a picture like that, this thing floating down a river. But there are all sorts of other things going on there at the same time in South Africa and worldwide. There are Energy Centres being developed in Kenya, for example. There are other organisations in South Africa that have been developing. So although it seems that we made a big contribution, and government thinks we did, I would hesitate. Just say it's part of a wider movement. (Bill Cowan, interview)

Other more limited policy impacts

A number of the policy briefs disseminated to policy-makers were mentioned in Section 4.4. Some of the policy briefings were more successful than others. According to Cowan (2004:69), it was unlikely that the brief on rural minigrids and hybrid systems influenced government policy in any way: “The brief was cautionary, and in effect argued against allocating earmarked government funds for doubtful minigrid projects. However, more persuasive arguments may have been presented by interested parties (including a World Bank/private company liaison).”

In another case, namely a briefing for proposals for youth roles in supporting rural energy development, poor communication with the relevant government departments led to a stagnation of activities:

It is not clear whether this brief was valuable. The communication channels became somewhat indirect, as the brief was prepared to assist DME staff to respond to requests from the Deputy Minister, and no feedback was received from DME staff. SEED did not effectively keep track of any subsequent developments in the DME/SANEA “Energy for Life” youth programme, which started in Northern Province (with involvement by SEED facilitator, Thomas Phooko). The idea at the time was to extend such youth-involvement programmes to other provinces, but we are uncertain about the status here. (Cowan 2004:69)

As mentioned, the use of video footage to convey information between rural communities and government officials appears to have been much effective.

In addition to the impact at the national government level, it is also anticipated that the Integrated Development Planning (IDP) process taking place within district municipalities will take account of and embrace the lower-level action plans developed in local communities: “In the Eastern Cape pilot district, the local energy initiatives were being fed into the IDP process, and SEED also assisted communications about grid electrification planning within the new IDP framework.” (Cowan 2004:55)

4.10 Information base for energy activists

Although an unanticipated outcome of the Rural SEED project, the *Rural Energy Guides* are regarded by Mr Bill Cowan to be one of the most useful outputs. The Guides are targeted primarily at ‘energy activists’ – in other words, people in community-based organisations or local government who are working on energy issues. The books are designed to be accessible and provide information to people engaged in those issues. Importantly, the content of the Guides is based on the information obtained via workshops with all the stakeholders, and is therefore relevant and useful. It is intended to equip energy activists with the information they need in order to do what they do effectively. Mr Cowan described some of the kinds of information contained in the Guides:

For example, if people in communities, or in a group of communities need to negotiate about getting electricity, grid electricity, then there are cost constraints. And it costs more to electrify over a spread out area obviously, or one area that’s remote from the system grid. So people involved in those negotiations need an understanding of what goes into the cost [unclear], and

that's pretty complex. Well, I wouldn't say it's complex but it needs quite a lot of explanation. So that would be one of the purposes of this. Another would be electricity use. People don't realise that an electric fan, for example, might consume only 1/20th as much electricity as a hot plate. And it's particularly important for poor people to know how to use electricity as economically as possible. There are questions like, is it cheaper to cook with paraffin or electricity or gas? And you'll find different answers to that around the country, in different publications. And as far as we can see, with the new Poverty Tariff electricity is clearly cheapest, but almost nobody knows that. So you'll find the poorest people are using more expensive fuels. [] And it's so difficult to work out what is cheapest. [] There are a lot of people who feel that an electric hot plate is the most efficient when it's at its highest heat, which is true when you bring water to the boil, but not when you're simmering a stew for two hours. (Bill Cowan, interview)

Dr René Karottki also reported that his participation in Rural SEED has informed both his current and previous policy work, for example, on the energy and poverty link that was one of the outcomes of the 2002 World Summit on Sustainable Development in Johannesburg (René Karottki, email). Dr Karottki highlighted the main lessons that he has gleaned from the experience:

I have used the Rural SEED experience both to document that rural communities (at least the ones we worked in, and others that participated in meetings) actually give priority to solving their energy problems, that they are ready to organise themselves around this, and that organising is crucial for community action in the energy field, e.g. to make formal agreements with service providers. This has also informed my present and previous policy work, such as e.g. on the energy and poverty link that was one of the outcomes of the 2002 World Summit in Johannesburg. (René Karottki, e-mail)

Dr Karottki reported that he was not aware of any other academics internationally who might have used the Rural SEED findings in some way.

5 Concluding observations and lessons learnt from this case

Operating within a participatory action research framework, the Rural SEED project (Phase 1) reflects an intricate weave of research, development and capacity-building activities, involving a wide range of stakeholders including research staff at the EDRC, Danish NGOs, members of pilot rural communities, national, provincial and local government, and energy suppliers. Given this framework, there is an epistemological and methodological link between the modes and contexts of knowledge production and utilisation that does not occur in other research designs. For instance, the design depends on the broad participation by the potential users in order to ensure the relevance of the approach, as well as the chances for successful uptake and implementation. Furthermore, the design provides for fluid and mutually-informing interaction between research-related activities (e.g. mini-surveys), action or developments within local communities, and the development of the knowledge and capacity of all those involved.

In the Rural SEED project, the more formal aspects of research were backgrounded and there was a greater reliance on the prior research knowledge of the project staff and the indigenous knowledge and practices of the local community members. This, together with the orientation towards action, meant that there was considerably less emphasis placed on more conventional academic or Mode I objectives, approaches and outputs. Indeed, as Bill Cowan highlighted, there had initially been some resistance from within the EDRC because the project was so applied, and therefore very close to crossing the border of what is conventionally regarded as 'academic' or 'university' work.

Only a selection of the large number and diversity of forms of utilisation were described in earlier selections. These included, amongst others, local activities in pilot communities, informing national policy and practice, capacity building and knowledge transfer, and the development of a 'model' that could be replicated elsewhere. This latter form of utilisation, namely replicating the 'best practices' associated with the development of Integrated Energy Centres, was highlighted as one of the more successful forms of utilisation, given the enthusiasm with which it has been taken up in government circles. However, according to Mr Cowan, this so-called "catalytic" influence of the project was perhaps too strong, and cautions potential users to ask questions about the conditions required for success, before initiating such developments elsewhere (Cowan 2004:56).

For instance, the Rural SEED Facilitators played a critical role in terms of getting developments in these communities off the ground. Cowan (2004:56) suggests that since governments and other organisations might not have the resources to employ full-time extension workers to do the work of the RSFs, they need to ask the question: "What lessons learned can be reasonably replicated, using normal available resources and structures?" Cowan (2004:39) also emphasised that "Establishing a community-based energy-development co-operative is [] a local activity which requires a process of development and training over an extended period of time." In other words, the urgency of government rollout and delivery will have to be tempered by the need for sufficient time for appropriate and sustainable training and support to be provided and structures to be developed.

For us, that took four years of intensive development with some, I'm thinking of Eastern Cape at the moment, some people working full-time, or over-time, everyday just with a couple of village areas. And now the government would like to roll out Integrated Energy Centres all round the country, but I don't see where the resources are, for that kind of slow development, for noses being followed. So I'm very cautious at the moment about the replicability of the approach that we took, because it was so resource-intensive. [] But I'm not sure the government has any other options, because I don't think they have the extension services. (Bill Cowan, interview)

What factors facilitated successful uptake by the South African government of the concept and practice of Integrated Energy Centres? In the first place, the government had already wholeheartedly adopted the 'integrated rural development' approach, as reflected in the ISRDS. Therefore, it was relatively easy for the notion of 'integrated energy centres' to be taken up. Secondly, the prevailing political climate also has a bearing on the extent to which project findings find their way into government circles. According to Mr Cowan,

“there’s a real desire among many of our leaders to listen to voices of people in communities”. More specifically, Mr Cowan reported that the current Minister of Minerals & Energy, Ms Phumzile Mlambo-Ngcuka, is very dedicated to rural energy issues and has, therefore, offered much support:

Phumzile is a person who really cares about development and about people and she’s been tremendously supportive for those kinds of developments. And even a factor as crude and simple as having a different Minister might have really detracted from the success of not just this project, but a whole of other projects. But it wasn’t just the luck of doing something at the right place and the right time. It was much more consultative than that. (Bill Cowan, interview)

The idea of the ‘information bridge’ was a novel and apparently successful idea, and no doubt made a positive contribution to facilitating interaction and action between the national and local levels. Using video footage to capture and communicate communities’ needs, ideas and problems to government and the broader energy sector, and to relay information about products and services back to the communities seems to have been a particularly successful strategy for the rural communities. For policy-makers and planners, Mr Cowan’s experience has shown that very short documents or policy briefs are the most effective, although he emphasises that face-to-face discussions and presentations are invaluable.

Maintaining this ‘bridge’ was greatly facilitated by the combination of Rural SEED Facilitators based in pilot communities, and EDRC staff based in Cape Town, who have good linkages with the national and provincial role players. However, as Cowan (2004:61) points out, playing the role of ‘information bridge’ was extremely time-consuming.

Despite these apparent successes of the Rural SEED project, the question remains as to what extent the project as a whole, as well as the initiatives in the local communities, are sustainable. With regard to the project as a whole, funding from the original donor ended at the end of Phase 1 and, at the time of finalising this report (September 2004), the proposed Phase 2 of the project was still not off the ground. At the local level, we saw, for example, that developments in the Ngwaabe district in the Limpopo province ground to a halt after the Rural SEED (Phase 1) came to an end, apparently for a number of reasons, such as the changes in management of the co-operative, and the discovery of the falsification of survey data supplied by the co-operative which was meant to inform the development of the business plan.

The lack of sustainability is often one of the challenges of community-based development projects such as Rural SEED, especially in the long-term when project teams have left the field and communities are on their own. It appears that the orientation of government towards sustainable energy ideas and the roll-out of Integrated Energy Centres in the thirteen nodal areas identified by the Integrated Sustainable Rural Development Programme, is giving continued life to at least some aspects of the broader programme. In addition, although difficult to measure, there is no doubt that capacity has been built and awareness raised amongst a broad range of stakeholders in the energy sector.

Data sources

Face-to-face interview

Mr Bill Cowan (Project leader, Energy Research Centre), 17 February 2004

Telephonic interviews

Mr Boyce Plaatjies (Rural SEED Facilitator in the Eastern Cape), 30 August 2004

Email response to questions

Dr René Karottki (Danish Technical Advisor), 31 August 2004

Mr Bill Cowan, 2 and 3 September 2004

Questionnaire

'Public sector R&D in South Africa: The production and utilisation of research'
questionnaire completed by Mr Bill Cowan, 2003

Publications and project documents

Cowan B (2004) *The Rural SEED (Phase I) Project, November 1998 – April 2003: Completion Report (Phase I)*. Cape Town: Energy and Development Research Centre

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Appendix: Examples of capacity building activities

Examples of the capacity building activities of the Rural SEED project are listed in the Completion Report as follows (Cowan 2004:28):

Groups affected	Examples of activities
Rural householders in the pilot districts	Door-to-door surveys of needs, and information sharing. Information at mass meetings. Participation in workshops. Energy Centre demonstrations, safety campaigns, pamphlets. Distribution of information from energy suppliers and agencies.
Energy/development organisations in these communities	Targeted information-sharing and action-planning workshops. Facilitation of organisational development & integration with local structures. Conflicts resolution. Contacts made to government, company and NGO representatives. Demonstrations. Training courses, e.g. on leadership and management, book-keeping, setting up and running co-operatives, safe supply of fuels, electrification options, etc.
Similar representatives from other communities	Shared information about progress in energy committees, energy centres and co-operatives. Books, pamphlets, demonstrations.
Local government representatives	Participation in energy-development workshops and organisational development of energy committees, energy centres and co-operatives. Facilitated contacts with government and energy company representatives. Participation in rural energy training courses. IDP (Integrated Development Planning) assistance.
School children	Information and demonstrations. Dramas. Inter-school competitions on energy and environment themes.
“Youth”	Participation in surveys, video productions, drama productions and local leadership roles. Facilitation of inclusiveness of youth and older people in organisational structures. Support for a DME/SANEA youth programme, “Energy for Life” (initially targeting rural youth in Limpopo province). Proposals for DME, for youth participation in the Integrated Sustainable Rural Development programme.
NGO development workers	Information/skills exchange, through collaborative work. Rural energy seminars for development NGO staff, based on project experience. Specific energy advice (mainly technical) on issues encountered by development NGO staff.
Energy supply companies, parastatals and associations	Participation in local workshops and meetings. Engagement in demonstration projects. Information about community-based development opportunities. Opportunities for working with such community-based organisations. Closer connections facilitated with local government.
Government staff and interns	Information communicated about local rural energy-development needs and opportunities to support local initiatives. Visits arranged. Presentations at national and provincial conferences. Representations and reports to politicians, Ministers and DME staff. Training support for new DME staff. Policy briefs.

Groups affected	Examples of activities
Parliamentarians	Periodic presentations to Parliamentary Portfolio Committees (Minerals & Energy, and Environment & Tourism). Information support for Budget-Vote speeches. Information support for particular MPs and sub-committees.
Students	Exposure to the methods, local conditions, strategic environment and action-paths experienced in the Rural SEED project, especially LA 21-type issues, for Masters students from Africa; and some from Europe, Asia and America.
Research staff, moving to government/ company/ NGO positions	Please see the comments in the text, and a following Table. There have been many participants in the Rural SEED project who subsequently moved into other important positions in the energy-development-environment sectors.
Aid agencies and consultants	Detailed local information (conditions, needs, structures, opportunities) for a variety of international consultants and agencies concerned with rural energy, renewable energy, and sustainable rural development. Contributions to project development in SA and neighbouring countries. Conferences. Commenting on aid-agency strategies, e.g. DANIDA/energy.

CONTENTS

Abbreviations	482
1 Introduction	483
2 The Electricity Basic Services Support Tariff (EBSST) project	483
2.1 The objectives of the research	483
2.2 The research team	484
3 Mode of knowledge production	485
3.1 The research approach and methods	486
3.2 The research output	488
3.3 A summary of the findings and recommendations of the reports	488
4 Mode of knowledge utilisation	489
4.1 Utilisation of the research in policymaking	489
4.2 Dissemination strategies	491
5 Conclusion	492
Data sources	493
Face-to-face interviews	493
Telephonic interviews	493
Questionnaire	493
Publications and project documents	493

Abbreviations

AMU	Association of Municipal Electricity Undertakings
BEST	Basic Electricity Support Tariff
DME	Department of Minerals and Energy
DPLG	Department of Provincial and Local Government
DWAF	Department of Water Affairs and Forestry
EBSST	Electricity Basic Services Support Tariff
EDRC	Energy and Development Research Unit
NER	National Electricity Regulator
SALGA	South African Local Government Association
UCT	University of Cape Town

1 Introduction

In the run-up to the local government elections in December 2000 the government announced its intention to provide free basic services, especially electricity and water, as a means of alleviating the effects of poverty. Soon after this statement of policy intent was made, the Department of Minerals and Energy (DME) convened a Task Team that comprised representatives from the National Electricity Regulator (NER), Eskom, the South African Local Government Association (SALGA), the National Treasury, the Department of Provincial and Local Government (DPLG), and the Department of Water Affairs and Forestry (DWAF).

At its first meeting, held on 9 February 2001, the Task Team was advised that its brief was to provide the Minister of Minerals and Energy with a set of recommendations on the introduction of an Electricity Basic Services Support Tariff (EBSST), which was earmarked for roll-out in April 2002 (Fowles 2004). In her budget speech to Parliament in May 2001, the Minister of Minerals and Energy, Ms Phumzile Mlambo-Ngcuka, stated that:

*In order to alleviate the negative impact of poverty on our communities, and in line with other national imperatives, the Department is developing an implementation strategy for the Electricity Basic Services Support Tariff. A multi-stakeholder Task Team has been appointed to lead the process, which culminated in a recent strategy development workshop. The task team is developing an implementation plan, first for the pilot projects targeted to nodal areas and metros leading the free basic services implementation. The focus of the Pilot Programme will be on funding, technology and implementation options. It is envisaged to commence these by June 2001. The phased rollout of the programme will commence in the 2002/2003 financial year following the results of the pilot programmes. (University of Cape Town, **Options for a Basic Electricity Support Tariff**, 2002: 7)*

The funding for the research – which was over R2 million – was provided by the DME, which gave Eskom the responsibility of commissioning and overseeing the research project. The initial research was conducted between October 2001 and February 2002, and culminated in the publication of a research report titled: **Options for a Basic Electricity Support Tariff**. A Supplementary Report was published a year later, in February 2003.

2 The Electricity Basic Services Support Tariff (EBSST) project

2.1 The objectives of the research

The central objective of the EBSST project – or BEST (Basic Electricity Support Tariff), as it later was referred to – was to undertake research that would provide the basis for the DME to make decisions regarding the implementation of a poverty alleviation programme through the provision of free basic electricity.

According to the Terms of Reference of the project, the objectives of the research were to:

- ◁ Investigate the proposed implementation of the EBSST
- ◁ Assess the costs, benefits and risks to the government and the national economy, and
- ◁ Provide a basis for making decisions regarding the implementation of the policy (Appendix A, **Options for a Basic Electricity Support Tariff**, 2002: 183).

2.2 The research team

The research team consisted of sixteen researchers, 11 were from UCT, and the remainder independent consultants who had had a long association with some of the UCT researchers. Prof Gaunt, who is from the Department of Electrical Engineering at UCT, led the research team. The UCT team comprised of researchers from a variety of disciplinary backgrounds, and were drawn from the following academic departments and centres:

- ◁ Applied Fiscal Research Centre
- ◁ Department of Civil Engineering
- ◁ Department of Electrical Engineering
- ◁ Department of Management Studies
- ◁ Department of Medicine
- ◁ Energy and Development Research Centre, and
- ◁ Energy Research Institute.

The EDRC with five of its staff members had the largest group of researchers in the UCT component of the team. A number of the units and departments in the research team already had a long relationship with Eskom. For example, the EDRC was busy conducting a study commissioned by Eskom – to look at how communities were affected by electrification – at the time the EBSST project was being developed.

Initially Prof Gaunt and his team were reluctant to take up the project because of the time that was allocated to do the research, which was three months, from November 2002 to end February 2003. As Prof Gaunt (from interview, 18 May 2004) has put it:

I recognised that it was a very big research project that exceeded our capability of doing it within the 10% of our time that we are allowed to spend on research. But this was going to take way over 20%, and they were looking for it in a hurry and I judged – quite accurately – that for the first 2 or 3 months it was going to be nearer 80% of our time. So I initially said “No, we are not prepared to do it”; and they put a lot more pressure on us. I think they looked around and spoke to some other people. And then they came back and put a lot of pressure on us, and I said we could not do it unless they spoke to the Deputy Vice-Chancellor and he authorised it as a university activity as it was beyond the area that our conditions of employment allowed.

Eventually the university agreed that it was not just a project of the research team, but would actually be a research contract between UCT, Eskom and the DME. In addition, Eskom had several concurrent roles in the EBSST project, namely to:

- ◀ Liaise with local authority electricity utilities, government departments, and with customers in the pilot sites
- ◀ Provide technical and financial data relevant to the pilot sites being investigated and ensure that the researchers had access to the pilot sites
- ◀ Assist the team in identifying and ensuring adequate representation of stakeholder experts and other parties in the various sectoral research groups, and
- ◀ Provide data on energy costing, operating costs, and tariff formulation. (UCT, 2002:5).

3 Mode of knowledge production

In tackling its brief, the research team regarded the research task as a complex one with many inter-related factors, which included:

- ◀ Establishing the feasibility of implementing the proposed tariff, as well as identifying possible alternatives
- ◀ Identifying the projected costs, benefits and risks to the implementation of the proposed tariff
- ◀ Identifying possible strategies offering the greatest benefit at the lowest cost and risk, and
- ◀ Identifying and establishing a baseline and process for subsequent evaluation and management of the implementation of the EBSST.

The research questions that flowed from the identification of the research problem were grouped into five sectoral issues, which formed the framework of the research and provided the basic structure of the research report.

The five identified sectoral areas, and some of the questions the research sought to answer, included the following:

- | | |
|---------------------------|--|
| Technical: | In what appropriate forms could the EBSST be implemented?
How will the changes in the behaviour of customers and their new load characteristics impact on electricity distribution networks?
What impact will customer response to the EBSST have on the generating capacity required to meet system demand? |
| Environmental and health: | What are the broad-scale effects of atmospheric air pollution on environmental health?
What are the possible local/household scale health effects of indoor air pollution?
Are there any carbon emission issues? |

- Social: What kinds of measurable social changes and effects on poverty alleviation can be expected from the EBSST in its proposed form (or alternative forms)?
How will the EBSST affect well-being, attitudes and awareness?
What are the requirements for effective delivery from the users' point of view?
What impact might be expected of the EBSST on electricity theft and non-payment?
- Financial and economic: Is it possible to evaluate the net annual financial cost of implementing each option and determine the impact the implementation of each option will have on:
- ◀ Expected number of beneficiaries
 - ◀ Household income (redistributive impact)
 - ◀ Poverty rates (poverty alleviation impact)
- What are the ways of financing the different options with reference to:
- ◀ Sources of funding: government subsidy versus an 'earmarked tax'
 - ◀ The impact of the financing options on the role-players in the electricity industry
 - ◀ Managing each of the financing options?
- What are the likely medium to long-term economic benefits and costs of the proposed EBSST?
- Institutional: What other government objectives related to electrification, restructuring of the electricity distribution industry (EDI), fiscal and economic policies, and social welfare will be affected by the proposed EBSST?
What is the DME's responsibility with respect to poverty alleviation?
How will the implementation of the EBSST be monitored?

In undertaking the above, the research team were advised to take into consideration the needs of the following stakeholders: The Ministry of Public Enterprises (responsible for Eskom, which generates most of the electricity), the Ministry of Minerals and Energy (which is responsible for energy policy and electricity regulation), the Ministry of Local Government (responsible for municipalities who, in turn, manage electricity service delivery), Ministry of Social Welfare and Development (responsible for social welfare and living standards), and the Ministry of Finance (who would ultimately be responsible for financing the tariff).

3.1 The research approach and methods

According to Prof Gaunt, the DME had initially asked Eskom to carry out some of the background research required in order to implement the policy intent of government.

According to Prof Gaunt (from interview, 18 May, 2004), however:

Eskom were basically not capable of carrying out that research, and they recognised that the work we [UCT] were already doing in the analysis of electrification, the effectiveness of electrification – which is work we did for the Development Bank of Southern Africa (DBSA) – and the National Load Research Project with which I had been involved for some 15 years, led them to ask us whether we would be able to help; and they really didn't seem to know what they wanted to research.

A workshop was held in early November 2002 to identify the objectives and constraints of the proposed EBSST, and to establish the research groups that would carry out the various sectoral analyses that were required. Meetings were also held with local government departments and utilities that were already implementing poverty support schemes, for example Pietersburg and Cape Town.

The research team also had periodic contacts with some of the key people in the two government departments that were involved in the project, namely DME and DPLG, as well as with Eskom and other stakeholders. According to the research report, this was done in order to ensure that the research team's assessment was compatible with the government's policies and objectives. It also reflects the complex nature of the dynamics within the project, which is reflected in the following extract from the interview with Prof Gaunt (18 May 2004):

The research was commissioned by DME because it relates to energy. And they provided the money to Eskom, which is an electricity utility. And we worked with the municipalities. When the government decided to implement this, they gave the responsibility to the DPLG, who hadn't read the reports, who had their own ideas, and who [were] working with a whole lot of authorities who don't want to read the reports.

According to Prof Prasad from EDRC, the stakeholders mentioned above did not, however, include the communities who were going to be the direct beneficiaries of the implementation of the policy:

[] they were not directly involved, and in my view, this is always a weakness in any policy...not all stakeholders were involved. Communities may have come up with something good, they usually do. (interview Prof Prasad, 11 May 2004)

The EDRC, according to Prof Prasad, became instead the “voice of the community” within the research project because of their extensive work with these communities.

Because of the varied nature of the sectoral areas under investigation, and the multi-disciplinary composition of the research team, the research methods that were adopted were equally varied. Some of the research groups, for example those covering the technical and the financial/economic sectors, used a combination of literature reviews, assessments of the pilot projects established by Eskom, and the use of scenarios and modelling techniques to explore various implementation options. The other research groups looking at social, health and environmental impact also reviewed the available

literature, conducted focus group research assessments, in the case of the social impact study, using pre- and post-implementation surveys in two urban and two rural sites.

3.2 The research output

The main output of the research project was a report titled: **Options for a Basic Electricity Support Tariff**, which was submitted to the Task Team on 28 February 2002. A follow-up Supplementary Report was published a year later in February 2003. The supplementary report provided findings and recommendations derived from further research that was undertaken by the team in the pilot sites, particularly with respect to the social impact, the technical feasibility, and the implications of the adoption of the proposed tariff. The other products of the research were in the form of working papers that were prepared for the project.

3.3 A summary of the findings and recommendations of the reports

Because of constraints of space, we will not be able to do justice to the full scope of the findings of the research project. The report looked at the various ways that a support tariff for the supply of free electricity to poor communities could be implemented, and also considered the technical, environmental, health, social, financial, economic and institutional factors for each of these alternatives.

The research established that a basic electricity support tariff:

- ◀ Would contribute to poverty alleviation, although this would be the case only for households with electricity connections and suitable appliances;
- ◀ Should limit the benefits to a clearly identifiable group. A broad-based tariff would provide the subsidy to all, irrespective of their need, but would recover the costs from those outside the target group, whilst acknowledging the leakage of benefits to those customers for which the subsidy was not intended. Alternatively, the subsidy could be provided only to customers choosing to transfer to a new, current-limited, tariff (called self-targeting), which would diminish the leakage of benefits to unintended recipients; and,
- ◀ Could be implemented using existing prepayment and credit meters, either with existing current ratings [20 and 60Amperes (A)], or with a new limit of 8 or 10A that load research shows is adequate for most poor households.

The basic requirement for electricity that would be sufficient for lighting, TV and radio access, and limited cooking – depending on the efficiency of the appliances used – was found to be between 35 to 60 kilowatt per hour (kWh), per month.

The key recommendations of the report were that:

- ⤷ The tariff be implemented on a national basis, without providing local electricity supply utilities with the option of ‘opting out’ of the system.
- ⤷ The tariff should not be one that provides free electricity, because of the problems that are likely to arise in the future¹. Instead, the first block of “basic” energy would be given at a heavily subsidised rate – at the price of R5 per 50kVWh - with energy used beyond this limit charged at the standard tariff applied by each utility for households.
- ⤷ A policy that would make it possible for poor households that were disconnected for outstanding electricity debt to be reconnected under specified conditions should be investigated.

4 Mode of knowledge utilisation

As far as Prof Gaunt’s assessment is concerned, the research was successful with respect to its first two objectives, namely to investigate the proposed implementation of the EBSST, and to assess the costs, benefits and risks (of implementation) to the government and the national economy. However, Prof Gaunt further makes the point that the research failed with regard to its most important objective, namely to influence the policymaking and policy implementation processes of government.

4.1 Utilisation of the research in policymaking

As it was mentioned in the section on research output above, the main product of the research was a research report, and a supplementary report that came out a year later, which laid out a set of recommendations with regard to the introduction of a basic electricity support tariff. The policy document that came out at the end of the process, and outlined the government’s position on the provision of a basic electricity tariff, was released in July 2003². However, the relationship between the research report and the policy document that it was meant to give rise to is a contentious issue. Prof Gaunt has stated that the research team was never invited to formally present the research report to the Task Team, nor did DME officials consult them during the process of writing the policy document. Mr Fowles - who served as one of the SALGA representatives on the Task Team - has concurred with Prof Gaunt’s view that the Task Team never formally discussed the report and, according to him, the report was not used in drafting the policy document.

However, the policy document itself states:

While noting that not all the research findings and recommendations of the [research] report were in line with the policy intent, the contents of the report were useful in arriving at certain policy recommendations.

¹ According to Prof Gaunt, there are technical reasons (of control and auditing) as well as social (demeaning impact of ‘free’ services) that the literature provides for not providing these kind of services ‘free’.

² Government Gazette No. 25088, *Electricity Basic Services Support Tariff (Free Basic Electricity) Policy*. Notice 1696 of 2003, 4 July 2003.

Indeed, the policy document claims that one of its key recommendations - namely that of providing 50kWh per month of free electricity targeting poor households - is based on the findings of the research. The policy document further states that it adopted the research report's recommendation of choosing the self-targeted approach as a method of delivering the tariff to the poor. However, Prof Gaunt has expressed serious reservations about aspects of the policy document, some of which are the following:

- ◀ That the document fudges the main policy issue - how to provide free basic electricity to the poor - in that the policy recommendations do not target the poor³, and
- ◀ That the people who drafted the policy document either didn't understand the research report itself, or made misrepresentations of it⁴.

Prof Gaunt's suspicions about the political 'use' of the research report seem to be corroborated by Mr Fowles who, in the telephonic interview (11 June 2003) stated that the DME officials who attended the very first meeting of the Task Team, which was held on the 9th of February 2001, submitted preliminary recommendations which were part of what was referred to as a "straw-dog" report.

One of the key preliminary recommendations was the provision of 50kWh of grid electricity per month to all qualifying households, which were defined as those households that earned less than R800 per month.

[] when we asked them why 50, their response was that 56% of all households in South Africa consume less than 50kwh per month. And where did they get this statistic? Well, they couldn't tell us where they got that statistic. So that's how it started. It wasn't very well co-ordinated and managed in my view. (telephonic interview Peter Fowles, 11 June 2004)

Prof Gaunt further argues that the DPLG has effectively "buried" the policy document, and that the municipalities continue to implement their own version of free basic electricity allocation. This is corroborated by Mr Fowles, who has indicated that in December 2002 the DPLG representatives on the Task Team had advised it that they could not accept the principles of the draft policy recommendations, and expressed the opinion that since electricity service delivery is a local government competence, the DPLG – and not DME – will decide on the policy regarding the allocation of free basic electricity (Fowles 2004:7)⁵. Further, contrary to the recommendations in the policy document, the DPLG later advised municipalities that they could decide themselves on who would receive the free basic electricity allocation, and the level of allocation they wished to provide (as long as it did not exceed 50kWh per month) (Fowles 2004:8).

³ Prof Gaunt argues that instead of the self-targeting recommendation that was made in the research report, the policy document, although mentioning self-targeting, actually provides a loophole for municipalities to extend the tariff to everybody.

⁴ According to Prof Gaunt, the figures quoted in certain parts of the policy document (e.g. Section 4.3.2, page 16) do not correspond to those in the research report.

⁵ According to Mr Fowles, the High Court challenge that was brought by the City of Cape Town, establishing their right to set its own tariffs, is part of this turf battle.

According to Mr Fowles, the publication of the policy by the DME in July 2003 took many role-players by surprise and resulted in a lot of confusion, since the DPLG had already undermined it by advising municipalities to implement requirements that were contrary to DME policy. As Mr Fowles puts it:

So, why I say there was confusion is that [the municipalities] were aware of what was going on (with regard to the discussions in the Task Team) as I was keeping the AMU (the Association of Municipal Electricity Undertakings) informed about where [the policy] was going. And all of a sudden they are summoned to a ‘road show’ by DPLG officials telling them not to listen to the Task Team. Then after they told this to the municipalities another government department (DME) publishes the policy. Now the policy says it must be self-targeted, DPLG says you can do it however you want; you can give it to everybody, you can give it to those in the indigent register. Now, to me a policy is a policy. That should have been the only way you can do it. But that’s not what DPLG said to the municipalities. (telephonic interview Mr Fowles, 11 June 2004)

4.2 Dissemination strategies

The researchers have disseminated the research results in a number of conferences and seminars⁶. Research team members have also made presentations to bodies such as the National Electricity Regulator (NER) and to the Parliamentary Portfolio Committee on Minerals and Energy.

The researchers are unable to publish the results of the report as they are prevented from doing so by confidentiality clauses in the research contract, which bar them from publishing in journals for two years. So for Prof Gaunt and his research team, the only option is to sit out these restrictions; as he puts it:

I’m just going to wait it out and then I can publish. Right now I’m in correspondence with a guy from the World Bank, who’s very interested. And they’re more interested than our own government officials now. Cause they see really big potential for this. (interview, Trevor Gaunt, 11 May 2004)

The research team has also experienced resistance in their attempts to disseminate the research report:

[O]n one occasion I was at a government Task Team meeting, and I said: “Look, we understand the importance of this [research project], and there is some other money available through THRIP and things like that supporting this research which gives us just a little bit of slack, and we would be prepared to go around the regions and give presentations regarding the research in the different areas to inform the municipalities - who are going to be very tied up in this – of the results of the research.” And they said: “No, no, no, we prefer to do it our way”. So, ja, that’s when I started to understand that they actually weren’t interested in the facts, but in putting across the policy of their own.” (interview Trevor Gaunt, 11 May 2004)

⁶ Papers have been presented to the Association of Municipality Electricity Undertakings (Southern Africa) Conference) as well as the Domestic Use of Energy Conference (see papers under Data Sources).

5 Conclusion

The primary mode of knowledge utilisation in this project was policy reform. The objective of the project, from its inception, was to provide an informed assessment of the government's policy intent, which was to alleviate poverty through the introduction of a basic electricity support tariff. Although the research, unlike many other policy reform processes, was conducted *after* the policy intent was agreed upon at the highest levels of government - rather than having preceded it - it does fall within the broad area of research *of, and for, policy*. However, since the end-point of the policy intervention was already decided upon, the focus of the research was on assessing and recommending the best options available to government, as well as the modalities of rolling out the implementation of the chosen option. A cynical view, perhaps, would be that the project was really an attempt to establish an evidence-based justification of a political decision that had already been made.

Indeed, as far as the project leader (Prof Gaunt) is concerned, the DME already had a position on the issue of basic electricity provision well before the research was commissioned. According to Prof Gaunt, the research was carried out for "political reasons", as there was no interest in the actual research results.

The research, in a sense, was wasted. I realised afterwards [that] some of the officials within DME had made up their minds before the research started about what they wanted, and they were badly wrong, and I don't think they ever listened. (interview Trevor Gaunt, 11 May 2004)

Incidentally, what was experienced by Prof Gaunt's corresponds with Weiss' (1979) notion of the political 'use' of research, where research is utilised by policy makers as legitimization or rationalization of previously arrived-at decisions, or is 'used' to provide ammunition for anticipated opposition to a policy proposition.

The case study also points to the pitfalls of a research project being caught up in the political 'turf-battles' of key role-players in government. According to Prof Gaunt, a part of the explanation why the research was not utilised and/or incorporated into policy as intended was that it got bogged down and entangled in the bureaucratic in-fighting of key government departments.

[] it boiled down into a fight between the Department of Minerals and Energy, which is responsible for energy and electricity policy and the National Electricity Regulator; the Department of Public Enterprises, which owns Eskom, and the DPLG, which owns the municipalities and all those electricity utilities. So there are deep political issues within Cabinet, between departments, major, major departments; on tariffs, on rates, all that sort of thing – it's unresolved; the government doesn't know what it's doing. And until they actually they settle down to decide something, they will continue not to know what they're doing, because they don't want to be convinced by the facts. (interview Trevor Gaunt, 11 May 2004)

However, a positive aspect of the project was the research process itself, which was very successful in harnessing the skills and expertise of a multi-disciplinary research team, which managed to produce, in a very short period, a very comprehensive research report.

Data sources

Face-to-face interviews

Prof Trevor Gaunt (Research Leader, EBSST Research Project, and Professor, Department of Electrical Engineering, University of Cape Town, 18 May 2004

Prof Gisela Prasad (Senior Researcher, Energy and Development Research Centre, University of Cape Town), 11 May 2004

Telephonic interviews

Mr Peter Fowles (Member of the EBSST Task Team, and President of Association of Municipal Electricity Undertakings), 11 June 2004

Questionnaire

'Public sector R&D in South Africa: The production and utilisation of research' questionnaire completed by Prof Trevor Gaunt on 10 May 2004

Publications and project documents

Department of Minerals and Energy (2003) *Guidelines for the Introduction of Free Basic Electricity Service*.

Gaunt CT (2003) "Researching a Basic Electricity Support Tariff in South Africa", Domestic Use of Energy Conference, Cape Town.

Fowles, T (2004), Implementation of a Free Basic Electricity Allocation.

Government Gazette No. 25088, *Electricity Basic Services Support Tariff (Free Basic Electricity) Policy*. Notice 1696 of 2003, 4 July 2003

Prasad G, Ranningen H (2003) "The social impact of the basic electricity support tariff in South Africa", Domestic Use of Energy Conference, Cape Town.

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CASE STUDY 12

THE KWAZULU-NATAL INCOME DYNAMICS STUDY (KIDS):

Crossing thresholds in poverty research in South Africa

A collaborative research project of the School of Development Studies (University of KwaZulu-Natal), Department of Agricultural & Applied Economics (University of Wisconsin-Madison), and the International Food Policy Research Institute

by Tracy Bailey



Inanda township just outside of Durban. Photograph courtesy of the SHAML website: [<http://www.shaml.org/agenda/2001/Durban/photos/>]

CONTENTS

Abbreviations	496
1 Introduction	497
2 The School of Development Studies (University of KwaZulu-Natal)	498
2.1 Brief historical sketch	498
2.2 Nature and organisation of the research	502
3 Overview of the KwaZulu-Natal Income Dynamics Study (KIDS)	504
3.1 Background to the KIDS project	505
3.2 The KwaZulu-Natal Income Dynamics Study (KIDS) (1998-2001)	515
3.3 The KIDS third wave (2004)	523
4 Mode of knowledge production	527
4.1 The collaborative research process	527
4.2 Different research modes and methods	528
4.3 Research outputs and dissemination strategies	529
4.4 Advancing knowledge and theory about the dynamics of poverty in South Africa	532
5 Mode of knowledge utilisation	533
5.1 Use of the KIDS data, findings and theoretical underpinnings for further research	533
5.3 Knowledge transfer	542
6 Concluding observations and lessons learnt	543
Data sources	547
Face-to-face interviews	547
Telephonic interviews	547
E-mail responses to questions	547
Questionnaire	547
Publications and project documents	547
Appendix 1: Professional backgrounds and research interests of the principal investigators	549
Appendix 2: Selected list of KIDS publications	553

Abbreviations

ANC	African National Congress
CASS	Centre for Applied Social Sciences
DFID	Department for International Development
GEAR	Growth, Employment and Redistribution
IFPRI	International Food Policy Research Institute
KIDS	KwaZulu-Natal Income Dynamics Study
LAPC	Land and Agricultural Policy Centre
NGO	Non-governmental organisation
PSLSD	Project for Statistics on Living Standards and Development
RDP	Reconstruction and Development Programme
SALDRU	South African Labour and Development Research Unit
SA-PPA	South African Participatory Poverty Assessment
SEMPI	Socio-Economic study of the Persistence of Poverty and Inequality
UNDP	United Nations Development Programme

1 Introduction

The single most important issue facing South Africa ten years after the transition to democracy is breaking the grip of poverty on a substantial portion of its citizens. There is a consensus amongst most economic and political analysts that approximately 40% of South Africans are living in poverty – with the poorest 15% in a desperate struggle to survive. (Landman et al 2003:1)

Arguably one of the most severe consequences of the apartheid era is persistent and widespread poverty in South Africa, and particularly amongst our rural populations. The quote above points to the fact that despite the new South African government's strong commitment to poverty alleviation – starting with the Reconstruction and Development Programme (RDP) and followed by a plethora of policies, legislation and strategies¹ – poverty is still one of the most critical problems facing the majority of South Africans.

Poverty is a worldwide phenomenon; but in South Africa, finding ways to combat poverty has been exacerbated by the lack of hard evidence as to the nature, extent and causes of poverty, and hence its possible solutions. According to Prof Julian May and colleagues (1999:2), “the absence of credible and comprehensive data on which policy, such as poverty reduction strategies, can be grounded” is another outcome of apartheid policy. They describe the problem as follows:

The previous regime had little interest in collecting information of this nature and, indeed, often suppressed data that depicted conditions in the former bantustan areas. For example, between 1976 and 1994, official statistics excluded the ‘TBVC states’, the homelands of Transkei, Bophuthatswana, Venda and Ciskei that were given nominal independence by the South African government. This automatically excluded a large proportion of the poor from official statistics. (May et al 1999:2)

The first attempt to measure the extent of poverty in South Africa *accurately*, and using a *representative sample*, took place in 1993 under the auspices of the Project for Statistics on Living Standards and Development (PSLSD),² led by the South African Labour and Development Research Unit (SALDRU) at the University of Cape Town.³ The survey sample included roughly 8 800 households and a range of demographic and socio-economic data was collected. According to May (1998:xii), the PSLSD survey data provided a critical quantitative baseline of the extent of poverty in South Africa, which went on to form “the basis for a wide range of policy analysis.”

¹ Examples include: the Poverty Relief Programme, the National Food Emergency Scheme and the Child Support Grant of the national Department of Social Development; the Poverty Reduction Programme of the national Department of Science & Technology; and, the Poverty Relief Programme of the national Department of Economic Affairs & Tourism. In addition, research funding agencies such as the National Research Foundation and the South Africa-Netherlands Partnership for Development have poverty reduction or alleviation as one of their focus areas.

² The preamble to the **Poverty and Inequality in South Africa** report (May 1998:xii) indicates that only two major studies had been done into poverty in South Africa previously; namely the First Carnegie Inquiry into poverty in 1922, which focused on the so-called “poor white problem”; and, the Second Carnegie Conference in 1983, which focused on poverty amongst the black population in South Africa.

³ This survey is referred to interchangeably in this report as the “PSLSD survey”, the “SALDRU survey”; and, the “1993 survey”.

This case study documents the initiation, progression and utilisation of the first longitudinal or panel study of poverty in South Africa, namely the KwaZulu-Natal Income Dynamics Study (KIDS). The KIDS project was undertaken in collaboration by researchers at the School of Development Studies (University of KwaZulu-Natal), the Department of Agricultural & Applied Economics (University of Wisconsin-Madison), and the International Food Policy Research Institute (IFPRI) in Washington DC. The KIDS project is an econometric analysis of persistent poverty, assets and income trends based on national survey data, a provincial panel study and qualitative research. One of the advantages of the KIDS longitudinal design is that, unlike the PSLSD survey that was a cross-sectional study, the KIDS project is able to identify and (to some extent) explain, the *dynamics* of poverty over time.

The structure of this case study is as follows. Sections 2 and 3 are primarily descriptive in nature – outlining the organisational contexts within which the KIDS project is located, as well as how it came about, and what and who it has involved. Sections 4 and 5 reflect on the various dimensions of the modes of knowledge production and utilisation.

2 The School of Development Studies (University of KwaZulu-Natal)

As was mentioned in the introduction to this report, the KIDS project was a collaborative research project involving researchers from the University of KwaZulu-Natal, the University of Wisconsin-Madison and IFPRI. Given that KIDS is a project about poverty in South Africa, and that Associate Prof Julian May⁴ and the School of Development Studies are the central figures in this collaborative endeavour, the focus is on the School in this discussion of the organisational context.⁵

2.1 Brief historical sketch

The School of Development Studies is located within the Faculty of Community & Development Disciplines at the University of KwaZulu-Natal⁶. The School as we know it today was established in 1954 as the Institute for Social Research. It is beyond the scope of this study to provide a detailed discussion of the development of the organisation over its fifty-year history. Instead, the major developments and changes over the years, focusing on the nature of the research, funding and structure of the organisation are traced.

The earliest annual report available in the School of Development Studies' resource centre is for 1974. At this time, Prof Lawrence Schlemmer, who had joined the Institute in 1964, had been the Director since 1972. The 1974 annual report (pp4-5) indicates that as far back as the early 1970s, the Institute was engaged in both basic and applied research. Applied research was undertaken for industry, private companies, and national, provincial and local government. Basic research focused on issues such as race and ethnic relations, and social stratification. In those early days, the Institute did not offer any teaching programmes of its own, but staff did undertake undergraduate and postgraduate teaching,

4 Although an Associate Professor, for the purposes of brevity Julian May is referred to as Prof May in this report.

5 Additional information is provided about Prof Carter and Dr Haddad and their organisational contexts in Appendix I of this report.

6 The University of KwaZulu-Natal was established on 1 January 2004 as the result of the merger between the former Universities of Natal and Durban-Westville.

and the supervision of Masters and Doctoral students (by Prof Schlemmer), in other departments.

It appears that most of the funding was obtained via sponsored research. Although an increasing amount of consultancy work was being undertaken, this did not always generate funds. The 1974 annual report (pp2-3) indicates the Institute's growing frustration with the demands and limitations imposed by having to rely to such a large extent on sponsored or commission research. Issues about funding were also being considered in light of the Van Wyk De Vries Commission of Enquiry into research funding at universities. One of the outcomes of this Commission was that the Institute for Social Research was renamed the Centre for Applied Social Sciences at the end of 1975 (CASS Annual Report 1976-1977, p1) and became a member-department of the Faculty of Social Science. In 1977, the new Centre offered its first academic course, namely a Postgraduate Diploma in Applied Social Sciences, with five students enrolled.

In 1982, the Development Studies Unit was established within CASS under the leadership of Prof Jill Natrass:

The Unit aims at providing a focus for the concentration of development efforts on the Third World environment in South and Southern Africa. In future the Unit will undertake research into the development needs of communities and regions in Southern Africa, motivation and organisation for urban and rural development and will evaluate practical alternative strategies for development. After 1983 the Unit will also become a teaching unit and offer course work towards the Masters Degree, specialising in Development Studies. (1982 annual report, p2)

In the early 1980s, the Centre obtained funding from both the University and from contract research that was undertaken. According to Associate Prof Francie Lund⁷, the Centre at that stage was relatively well endowed, both in terms of tenured staff and funding. This allowed researchers like Prof Lund considerable free reign in terms of the activities they were involved in:

External funding was needed. Laurie Schlemmer did a couple of big things for local government at that time, which I know were under contract. But we were incredibly well-off compared to other institutes in terms of, we were full-time paid people. So I could do all my community activism and running Tongaat health-screenings for the embryo of the UDF [United Democratic Front] kind of thing, with no money at all, just my time. (Francis Lund, interview, 14 June 2004)

The year 1983 appears to have been a particularly busy one in terms of the growth and expansion of the Centre. Firstly, a Data Resource Unit was established which aimed "to collect and analyse indicators of social change and development in South African society" (1983 annual report, p2). Linked to this was the establishment of a quarterly journal, *Indicator SA*, through which research results were disseminated. Jill Natrass also established the Rural-Urban Studies Unit in 1983 under the auspices of the Development

⁷ Although an Associate Professor, for the purposes of brevity Francie Lund is referred to as Prof Lund in this report.

Studies Unit, which aimed “to study the dynamics of the linkage between urban and rural areas” (1987 annual report, p v). The teaching programme at the Centre was also expanded in 1983. Firstly, an Honours programme in social development was introduced. Secondly, a Community Service Training Programme was initiated, which offered “a certificate course designed to assist experienced administrators and community workers to acquire the theoretical knowledge and practical skills for development and programme administration” (1987 annual report, p vi).⁸

In 1984, the Maurice Webb Trust endowed a Senior Fellowship in Race Relations to the Centre that resulted in the establishment of the Maurice Webb Race Relations Unit:

The Unit undertakes research and publishes specifically in the field of race relations and problems surrounding the issue of race in South Africa. During the year under review the Unit introduced an apprenticeship programme specially designed to train black social researchers. (1987 annual report, p v)

The mid-1980s heralded some significant changes in the leadership and structure of the Centre. In 1986, Prof Schlemmer left the Centre to take up a position elsewhere. As a result, the Centre operated without a head for the whole of 1987 (1987 annual report, p iii). Also, on the 22 December 1987, Prof Jill Natrass was killed in a car accident.

In the same year, both CASS and the Development Studies Unit were subject to a routine review. The main recommendation that emerged from this review was that the Centre and the DSU “should be formally reintegrated under one directorship” (1987 annual report, p iii). During 1988, CASS and DSU were amalgamated into a new unit called the Centre for Social and Development Studies (CSDS) and effectively left the Faculty of Social Science. This meant that the new Centre no longer offered any teaching programmes – at either the undergraduate or postgraduate levels – although staff did continue to offer teaching and supervisory services in other departments (1989 annual report, p1). Prof Simon Bekker assumed the position of Director in October 1988.

The new CSDS focused on both basic and applied research “with a strong emphasis on social development of a society in transition”, as well as social research and postgraduate training (1989 annual report, p2). The CSDS also encompassed the three specialised units, namely, the Maurice Webb Race Relations Unit, the Indicator Project South Africa, and the Rural-Urban Studies Unit. The CSDS remained the umbrella organisational entity for more than a decade. During this time, in 1995, the Centre introduced a Masters programme in Development Studies that provides multidisciplinary training to future researchers, policy analysts and practitioners.

In 1998, in line with changes in the broader institutional context, the Centre’s status changed to a ‘school’, and became the School of Development Studies, with Prof Mike Morris as the new Director.

⁸ In 1988, the Programme was transferred to the Department of Social Work, although CASS staff continued to contribute.

Prof Vishnu Padayachee, the current Director of the School, described these broader institutional developments as follows:

What happened was that I think about five years ago there was a move to get rid of very small departments, and to move small departments into cognate departments and call whatever came out of it a 'school'. So there were all kinds of things that happened and it was supposedly for academic reasons but it was largely about money. [] mathematics, applied mathematics, statistics made, they were all separate departments and they became one School of Mathematical Sciences, for example. Economics, we had something called Financial Economics, whatever it is, they all became the School of Economics. We simply combined the Centre with the School and made a school. (Vishnu Padayachee, interview)

According to Prof Francie Lund, the CSDS title still gets used, although less so now than in the early days:

The CSDS still exists, kind of on paper – it's still on our letterheads. It's a figment and more and more it's falling away. (Francis Lund, interview, 14 June 2004)

In 2001, the School introduced a new research programme in Population Studies, which includes a Masters in Population Studies, and short training courses for government officials. In 2002, Prof Vishnu Padayachee was appointed as the new Director, and the Centre for Civil Society (CCS) was established within the School. The CCS provides training to NGOs and other sectors of civil society.

Today, the School has a strong contingent of teaching and senior research staff, as well as a number of researchers on contract. According to Prof Padayachee, the large number of tenured staff in the School and the good financial support from the University since the mid-1990s is a reflection of the fact that the School is no longer under any great pressure to raise external funds in order to survive:

I don't think we – in the last ten years – felt any great pressure to go and raise money to support, you know, our own existence. We do raise money, but we raise it because we want to raise it in particular areas and we don't have to. We have a huge number of tenured staff. [] We are seen as being a very major school in the Faculty and the University. So of course you always struggle to get new tenured posts and so on, but we've managed to secure that in a climate which, these things are not easy. We've been able to raise the number of tenured staff, especially in areas such as Population and so on, which we needed to do in a few other areas. (Vishnu Padayachee, interview)

The School maintains an impressive array of local and international linkages and collaboration, which is reflected in the project team of the KIDS project.

2.2 Nature and organisation of the research

The general orientation to research and teaching in the School is described on the web site as follows:

The School is a multi-disciplinary research and graduate teaching institution at the University of KwaZulu-Natal in Durban with a primary focus on development and reconstruction. A leading centre for research and teaching on development in South Africa, we also hold an international reputation for the quality of our work and the intellectual rigour with which we apply academic skills to policy challenges. The School draws on the specialist knowledge of our researchers who are nationally and internationally recognised experts in the following areas: economic development, social policy and poverty, global trade, urban policy and the politics of space, civil society and development and population studies. (<http://www.ukzn.ac.za/csds/Index.htm>)

There are three important features of the way in which this group thinks about their research, which are borne out in the KIDS project. The first is that while the substantive focus of the research is rooted in the South African context, the researchers locate themselves internationally. As the quote above highlights, researchers focus on attaining both national and international status. Indeed, over the years, the School has spawned a wide array of scholars and researchers who today play a significant role in research for economic development and poverty alleviation, amongst others.⁹

The second feature is the explicit emphasis on producing research that is relevant to the South African context and which can inform policy development. The School therefore places a strong emphasis on networking and building linkages with external stakeholders and potential users (especially in government), and ensuring that their research is always 'relevant'. Prof Julian May commented on this orientation as follows:

I don't think any of the tenured staff here would say they are just an academic. Everyone wears at least two hats. So Vishnu is on the governing body of the Reserve Bank. I'm on the statistics council. Imraan Vilodia works at the [Dept of Trade & Industry] branch. I don't think there's a conscious, a written-down policy but I think that there's an expectation and substantial peer-pressure here that your work be relevant. It would be, any project that gets initiated here, we have a workshop every Monday where people present their work-in-progress or what they're planning to do. Then your colleagues are able to comment. And it would be quite difficult to do, I think, potentially irresponsible research. I think the comments are made about recognising what you're doing to a respondent. It would be very difficult for me to design a research project that tramples all over respondents because a colleague here would say, you can't do that! It is ethically unacceptable. It would be very difficult for someone here to do a study without looking at HIV/AIDS, because I would say something about it. There is a strong, I think,

⁹ Examples include Paulus Zulu, Catherine Cross, Harriet Sibisi, Doris Sikhosana, Valerie Møller, Elizabeth Ardington, Francie Lund, Julian May, Gerry Maré, Mike Morris and Dulcie Krige, all of whom were either research fellows, research assistants or students.

respect for one another in the Department because people keep playing these different roles. (Julian May, interview, 9 October 2003)

Thus, while ‘blue sky’ research is done in the School, according to Prof Padayachee, the expectation is that this is always linked to engagement with the ‘real world’. And, while there is no formal policy about the dissemination of research findings, it appears that researchers simply do this as a matter of course. Both the linking of research to ‘real world’ problems, and active dissemination to and engagement with potential users is greatly facilitated by researchers’ participation on various boards and committees. The following quote from the interview with Prof Padayachee speaks to these issues:

There are no blue sky researchers here. A lot of us are capable of doing it. But it’s that interaction that we’ve started to think about between – Mike [Morris] spoke very passionately about it in the mid-nineties when he was trying to get a whole lot of us to come here – between the world of serious intellectual writing and engagement. Publication in top international journals and national journals to us is very very important. But that must be coupled with, and I think it benefits from high-powered graduate teaching and an acute awareness of what and how research and teaching can make a difference to the real world, in the broadly economic development and social development areas that we work in. Francie’s work on the Lund Commission, on child support grants, you know, all of us have served at various times on major commissions and boards, councils and so on. And we do that not because it’s nice to be on these things, it’s nice to be on the Board of the Reserve Bank, but it’s because in a sense I’m on the Board of the Bank because of my work, not the other way round. So that this is like an extension of things, and having in each of our areas this range of constituencies, if you like, policy world, I mean constituents in the broadest sense, is almost natural. It’s what we’ve come here for, because many of us are attracted by that idea that you can do serious work, publish, that you can do high-powered teaching that feeds back and interacts with the teaching/research thing, and each of those is linked to the policy world. Our graduate students end up in, you know, the very places, the Reserve Bank, the [Department of Trade & Industry], in local development, in NGOs, trade unions or banks, financial institutions, all of which are our constituencies as Faculty. So you know we are just extending our family in a sense. (Vishnu Padayachee, interview)

The third feature of the approach to research in the School is the strong focus on training and capacity building, and especially of black students. This orientation also has a long history – even during the apartheid era. For instance, the 1974 annual report (p17) indicates that the Institute for Social Research had a strong commitment to provide research training “for black graduates who have an interest in community development and related areas, in which research plays an important role.”

Over its history, the School has incorporated a broad array of disciplines under the umbrella of ‘development studies’. To some extent, this is still the case today, with researchers coming from diverse disciplinary and research backgrounds. However, there

is currently a much larger proportion of economists and demographers among the staff, which, in recent times, has resulted in a stronger focus on the economic features of development. According to Prof Padayachee, the economics focus is split into macro- and micro-economics, with an emphasis on social policy and poverty in the micro component. These two broad research focus areas do not operate in isolation; instead, Prof Padayachee used the metaphor of “porous silos” to describe the way in which the different areas of research in the School must ‘talk to’ and feed into one another:

None of these silos, if you like, are so watertight. I don't want watertight silos. I want them to be impressionistic areas that will define mainly, that will inform where there are gaps, where we need more people, if we're looking for staff we want them here, etc. It allows us to identify things like that for resources and so on. But it's not meant to create units and programmes which don't speak to one another. [] Ja, it's important to make these, to be clear about the fact that there are these different things. But it's not for the sake of further refining them and driving them apart, it's to allow debate and discussion to occur across them in a more fruitful way. (Vishnu Padayachee, interview)

In general, research focus areas within the School (and previously as a Centre) arise around the research interests of the individual researchers. However, Prof Padayachee reported that as Director, he is trying to achieve a much tighter focus:

When you have something like development studies which can be everything and anything, you have to actually say, we're not just some kind of place where anybody who feels either alienated from their other cognate disciplines or don't like somebody somewhere else, will want to come and gravitate here. They have to say now, and justify this, when we employ staff, when we look at new projects, when we consider things, we now are much clearer. And it's only really in the last year that we've been able to do that. (Vishnu Padayachee, interview)

The three Masters programmes – in Development Studies, Population Studies, and Development Planning – allow for a much broader disciplinary base in terms of specialisations.

In summary, at least since the 1970s, the organisational entity – variously ascribed the status of ‘Institute’, ‘Centre’ and now ‘School’ – has a long history of both basic and applied research. The researchers have always maintained linkages with external stakeholders and, more recently, place enormous emphasis on the relevance of their work, and the dissemination of these findings in order to inform policy. All these features are evident in the KwaZulu-Natal Income Dynamics Study, the core focus of this case study.

3 Overview of the KwaZulu–Natal Income Dynamics Study (KIDS)

The KwaZulu-Natal Income Dynamics Study (KIDS) involved the re-surveying in 1998 of a sample of households in KwaZulu-Natal that were surveyed in 1993 as part of the SALDRU survey. As an econometric study, the KIDS project involved the analysis of household data in order to identify persistent poverty, assets and income trends. Although

not originally planned, during the course of the project a qualitative component was added which focused on a subset of the households in the sample. At the time of writing this report (June-August 2004), a 'third wave' of the KIDS project is underway, in which the same sample of households are being resurveyed.¹⁰

The idea for a longitudinal investigation into poverty in South Africa, and the particular research design and approach, emerged over quite a long period of time. Thus, before describing the KIDS project itself, I first consider the background and the broader context within which the KIDS project emerged and evolved, highlighting the different individuals and organisations involved, and the key theoretical developments. The narrative which follows centres largely around Associate Prof Julian May, an economist based at the School of Development Studies at the University of KwaZulu-Natal, who was the common thread between these various developments. However, the perspective of the two other project leaders, namely Prof Michael Carter at the University of Wisconsin-Madison, and Dr Lawrence Haddad at the International Food Policy Research Institute in Washington DC is also considered.

3.1 Background to the KIDS project

The starting point for this narrative is the Project for Statistics on Living Standards and Development (PSLSD) in 1993. This is for two reasons. The first is that the KIDS project – the focus of this case study – incorporates and, therefore, depends to a large extent on a sub-sample of the PSLSD data. The second reason for this point of departure is that the PSLSD survey opened the door for researchers such as Prof Julian May and Prof Michael Carter to gather more empirical evidence, explore theoretical ideas and, in the long run, make a valuable contribution to the analysis of the dynamics of poverty to inform poverty-related policy.

The Project for Statistics on Living Standards and Development (PSLSD) (1993)

The PSLSD was the first representative national household survey undertaken in South Africa. The project was led by the South African Labour and Development Research Unit (SALDRU) at the University of Cape Town, and the research was undertaken in collaboration with a consortium of South African survey groups and universities (May *et al* 1999:2). Funding and technical support for the PSLSD team was provided by the World Bank, and the governments of Denmark, The Netherlands and Norway.

The PSLSD was initiated in 1992, not long after the unbanning of the African National Congress (ANC), and in anticipation of the information needs of the new democratic government. The idea for such a survey arose out of the interaction between the World Bank and the ANC, and particularly Nelson Mandela, around poverty alleviation in South Africa. A steering committee was set up comprising both academics and activists (such as Trevor Manuel, Patricia de Lille and Alec Erwin), whose task it was to tease out the issues and design the survey.

¹⁰ In this case study report, the 'second wave' of KIDS refers to the 1998 survey, while the 'third wave' refers to the 2004 project.

Prof Julian May, who was a member of the steering committee, described the situation as follows:

As I understand it [the initiation of the PSLSD] had been prompted by a meeting from, when Mandela met with the World Bank to talk about World Bank engagement in South Africa, and indicated that the ANC wanted to focus on poverty reduction as a major policy, wanted World Bank assistance with poverty diagnostics. The Bank, as part of its engagement with South Africa, is required to produce a poverty assessment and part of that poverty assessment is a survey, a national survey. Not surprisingly, the Bank was very willing to meet Mandela's request, to undertake some kind of representative survey of the whole of the country. I think SALDRU at UCT was picked because of Francis Wilson's pioneering role in the Carnegie Report in '83 and SALDRU adopted an approach of working with provincial organisations to collect the data. (Julian May, interview, 9 October 2003)

The primary purpose of the PSLSD was

... to collect hard statistical information about the conditions under which South Africans live in order to provide policy makers with the data required for planning strategies to implement such goals as those outlined in the Government of National Unity's Reconstruction and Development Programme. (PSLSD 1994, quoted in May et al 1999:2)

The PSLSD survey is similar in design to the Living Standards Measurement Surveys conducted by the World Bank¹¹ since the 1980s and, as such, was a cross-sectional survey. The sample included approximately 8 800 households across the country. The survey gathered information on household demographics, household environment, education, food and non-food expenditures, remittances, employment and income, agricultural activities, health and anthropometry (Carter et al 2003:4-5; May et al 1999:2). In addition to the household survey, a community survey was administered which sought to collect information on, for example, "school availability, health care facilities, and prices for various commodities" (May et al 1999:2-3).

The design and implementation of the PSLSD survey involved mass participation by various organisations around the country. At the time, Prof Julian May was working for a Durban-based non-governmental organisation called Data Research Africa¹². The DRA was approached by SALDRU to undertake the fieldwork in KwaZulu-Natal, which they did. Prof May explained why he and the DRA were selected for this task:

DRA had worked on a series of income and expenditure studies in KwaZulu-Natal. I had been involved in several of these studies, both in this institution [University of Natal] in the early 1980s and then again in the early 1990s. I had had quite a lot of experience working in rural areas and in township areas of KwaZulu-Natal. (Julian May, interview, 9 October 2003)

¹¹ The survey model adopted in the SALDRU study, based on the World Bank's Living Standards Measurement Surveys, was subsequently adopted by Statistics South Africa for their annual October Household Surveys.

¹² In an interview (9 October 2003), Prof May described the DRA as being "somewhere between an NGO and a private sector development organisation based in Durban" that they had established out of the Centre for Social & Development Studies. The DRA has since changed its name to Development Research Africa.

First round of analysis of the PSLSD data (1994–1995)

According to Prof Julian May, the PSLSD survey went off fairly smoothly and it took a few years for the data to be processed. There was a hitch, however, in that no funds had been made available for the analysis of the data. In addition, it also became clear that the World Bank intended to undertake the analysis themselves and not involve any of the South African researchers. Prof May described the situation as follows:

But what emerged in the year or so after the data collection was that although money had been made available by the World Bank to collect the data, there were no resources to analyse it. And, in fact, what was starting to emerge was that the data analysis was going to take place in Washington. Very few South Africans at that point had the quantitative skills to engage with the analysis and there were a few people around the country – Servaas van den Berg being one of them at Stellenbosch, Charles Simkins I think at WITS, and myself in Durban, but there were a handful of researchers that actually starting engaging with this information and there were no resources to do so at all. (Julian May, interview, 9 October 2003)

At the time (1994), Prof May was working closely with Ms Diana Callear at the Land and Agriculture Policy Centre (LAPC), whom he approached for assistance in finding funding for a South African analysis of the PSLSD data:

The LAPC was one of the think tanks that the ANC set up to help develop policy, and obviously the particular focus was on land reform. Diana had led a quite substantial programme, roughly from '93 through to '95 I guess, in doing research for the land reform, current land reform, which in a number of papers had engaged in different ways of thinking about land. My own area of focus has always been poverty, but a second kind of level would be on rural development. That's why I got involved in that analysis. I then wrote to, after discussing with Diana about this – the perceived lack of funding to do analysis using the SALDRU survey – put a proposal to Diana that we need to set up a team to do this analysis, to try and find funding. And I think LAPC's main purpose was, it's main way of working was to source funding to commission research, not to undertake it themselves and then to try and integrate it into the policy documents that were being formulated at the time. I think Diana liked this idea a lot and I was speaking to her at a time when a lot of the research being undertaken in South Africa was kind of short-term imperatives for immediate policy development. I think she saw the benefit of something that was maybe a stand-back exercise. It was unclear at this stage what, where this might go. (Julian May, interview, 9 October 2003)

The specific question that Prof May had in mind was to what extent having land made a difference to poverty. Prof May had been working on the idea of “sequencing policy”, i.e. whether it is useful to think of introducing policies in a particular sequence to ensure optimum effectiveness.

Ms Callear managed to source some funding from the division of the World Bank with which she had been working around land reform issues. The funding came with a condition, however; namely, that one of the World Bank's technical advisors had to join the team. The technical advisor was Prof Michael Carter, who later became one of the core collaborators of the KIDS project. The following two quotes Prof May's and Prof Carter's perspectives on their meeting:

I've always joked about this – I think the Bank thought if they need to deal with these crazy South African Stalinists, then they're going to have to bring in a 'real economist'. And someone who is now, I think he's still the Vice President of the Bank, his name is Roger van den Brink, was working on the land reform in South Africa. He had studied at the University of Wisconsin-Madison and was the professor of someone called Michael Carter. [] Roger recommended to the Bank that they appoint Michael Carter as a technical advisor to the South African team. [] Obviously, our own reaction in South Africa when we got the news that they would fund us, but only if we had one of their people, was typical! They're trying to control us again! And I picked Michael up from the airport with some hesitation and, this is Michael [points to a photograph of himself and Michael that was pinned on the notice board] and as you can see Michael is a typical economist, he's got gold-rimmed glasses! He got off the plane and I thought, oh dear! But fortunately we discovered two things: one, we have strong common interests in food and wine and second, what they weren't aware of is that Michael is somewhat of a fallen neoclassical economist. He was trained at the University of Washington in a very high level of neoclassical theory and skills, but is fascinated about how markets work unevenly, and particularly for the poor. He's fascinated about how power shapes economic relations. Very interested in the link between sociology and economics, social networks. A lot of this wasn't, there is now a big literature about this, I'm sure you've come across the social capital literature. At that point, in 1994 or thereabouts, it hadn't actually come out in the literature. And what the Bank didn't realise is that I'm somewhat of a fallen Stalinist, I know I'm essentially a quantitative economist but I have a strong interest in political economy. But I do not see myself as part of the 'loony left'. So, we developed a very good collaboration. We formulated a project to analyse the KIDS data. (Julian May, interview, 9 October 2003)

I was sitting around in my office. It must have been March, maybe, of 1994. The SALDRU data had just been collected and my understanding was that the World Bank was extensively involved in helping with that original SALDRU data collection. A former PhD student from my department, someone of the name Roger van den Brink, who continues to work with the World Bank, who was part of a World Bank mission team. I believe at the time, at that date back in '94, he was actually in Cape Town, working with the SALDRU people and working out arrangements for the analysis of the data. Now there's a little bit of folklore which I'm not entirely sure is true, but I like to repeat it because I can be irresponsible! My understanding of the folklore was that SALDRU had basically finished entering and cleaning

the data and were about to take the data back to Washington DC to undertake whatever analysis they wanted to do with that initial study. And I gather that there was a certain amount of discomfort expressed at this meeting at SALDRU about the apparent lack of interest in including any South African analysts in the work. So I've always imagined that, given the relationship at that moment in history was a bit rocky between the World Bank and South Africa, I'd always imagined that the head of the World Bank mission at that time suddenly declared that he needs to go to the toilet, you know, cleared his throat. A group of mostly men, I hope, but maybe not, followed him into the rest room saying, oh my God, what are we going to do with these South Africans who are unhappy with us? And, they're going to kick us out. And again, part of my recreation of this legend is that they came up with the idea that they needed to make a small grant, or facilitate a small grant for some analysis to be done in South Africa. And then they confronted the issue of how would they get these incorrigible South Africans to actually do any kind of decent analysis? And that's where this guy Roger van den Brink said, I know the perfect person who can work with these wicked South Africans. He's a difficult person also and he deserves to be punished! [] I always imagine – cell phones weren't quite what they are now in '94 – but I always imagine that van den Brink picked up the cell phone in the men's toilet and rang me up and said, there are these crazy South Africans, they're renegade Trotskyites just like you, and you'd really like to work with them! That's a bit of a fictionalised account. What I know did happen for sure is that van den Brink did call me from South Africa and indicated that they were making a small grant [] So I told van den Brink I was certainly interested in the issues and then Julian and I got in contact and Julian faxed me some kind of brief description of what he was thinking about doing. I found it interesting and we talked on the phone once or twice. (Michael Carter, interview, 9 June 2004)

The World Bank made a grant for the project to run from 1994 to 1995 and, in July 1994, Prof Michael Carter flew to South Africa to start work on the SALDRU data. He and Prof May brought in two young researchers (Dorit Posel and Ranveer Persad) to assist with the analysis. The primary output of this phase of the analysis was a monograph entitled ***The composition and persistence of poverty in rural South Africa: An entitlement approach***, which was published as a LAPC Working Paper.

According to Prof Michael Carter, it was during this period of analysing the SALDRU data that he and Prof May realised the need to re-survey the households to acquire longitudinal data. For Prof Carter, the idea was clinched in an aeroplane flying over Port Elizabeth on one of his trips to South Africa:

My memory is that we started talking about that in an aeroplane over Port Elizabeth. The reason I have that kind of memory is because we were flying back from Cape Town, maybe we had gone to see SALDRU or somebody at the University of the Western Cape, or both, and we had this incredibly talkative pilot! That's why I remember this guy. He was like, oh my God, if you look out of the left side of the window you can see a large

rock! It was sort of funny, you know. [] And where I started coming from, my father was from the southern part of the United States and had done a little bit of my growing up there. And my very first visit to South Africa [1994] I was kind of reminded a little bit of the US south in terms of racial attitudes and methods of formal segregation and stuff like that. And you know, the US has its own not particularly outstanding history – what happened economically since the Civil War and kind of the formal end of the US version of apartheid. And, talking about these ideas, and just those simple reflections with Julian, we began talking quite early on about really wanting to follow up and let's see what happens here. In a sense I always viewed it as a great experiment that South Africa was undertaking in terms of eliminating major systematic discrimination against a class of people, and then changing the rules, and then more or less hoping that everybody could then live in peace and move forward together. A little bit cynically, but I hope realistically, that's kind of what happened in the US as well, but I'm not sure it worked all that well. So I became interested in the panel from that perspective, given that where we were, I'd say now, but certainly in the mid-nineties in terms of what the sort of general development policy debate was. [] So I was intellectually quite interested in wondering how that would really work out in the case of South Africa with its particular history and legacy. (Michael Carter, interview, 9 June 2004)

Further analysis of the PSLSD data (1995–1996)

Prof May and Prof Carter then decided to embark on a second round of analysing the PSLSD data in 1995. Prof May approached Ms Callear at the LAPC again with regard to funding. Diana managed to secure some funding from the Ford Foundation and the analysis proceeded. This project started in 1995 and was still being wrapped up at the time of the August 1996 workshop.

According to Prof May, he and Prof Carter extended their practice of involving young researchers as a way of building capacity, via the practice of 'peer-on-peer learning' between students from South Africa and Wisconsin, in particular, pairing an advanced PhD student – with extensive experience and familiarity with advanced theoretical and statistical techniques – with younger Masters students.

Again, went back to LAPC, back to Diana with a proposal, with a set of ideas. A bigger emphasis on the training side again because we felt that this methodology that we had set up went quite well. One of the innovations that we introduced, and we introduced at this early stage, in this first phase, is that Michael had a PhD student from Wisconsin and we teamed that PhD student with the South Africans. So there was a kind of peer-on-peer learning that we tried to set up. So we proposed doing a similar kind of exercise again. This time Diana went to the Ford Foundation which provided another possibility to take the analysis further. It allowed Michael and myself to develop our own work a little bit more without dependence on the World Bank, from Bank influence. We brought on three younger researchers, [] they were actually completing their Honours, and the proposal was that we would fund their Masters degrees – one in sociology, two in economics, and

there would be some process to transfer their skills. Once again a counterpart was identified at Wisconsin who could interface with these students; they were definitely more junior than the first group. (Julian May, interview, 9 October 2003)

The primary output of this phase was the publication of an article entitled **Poverty, livelihood and class in rural South Africa** in the journal **World Development**. The researchers also made various presentations on the findings to the LAPC and other government bodies. Prof May described some of the methodological and theoretical work that was done during the course of the analysis:

*Michael and myself firstly started using some of the new tools that were available for measuring poverty, now very common but at that point the different measures of poverty had only recently been developed, in '94 or something. So, we used these new tools to measure poverty. And we also tried to look at how households combined assets and what combinations of assets seemed to generate the best results. So, if you've got a small amount of land but a lot of money, is that better than having a lot of land but no money? And we generated I think a couple of working papers and an article in **World Development**; I think it was 1999 when it was eventually published. We presented those ideas, quite widely now in America and in South Africa and in Europe, talking about this, we call it, we joke about it, there's a picture in the article where we use a three-dimensional analysis, you get a thing that looks like a flying carpet, and essentially that flying carpet shows that at certain levels, it looks like if you don't have enough assets, or the right combination of assets, you don't seem to be able to generate very much from them, and simply increasing one of those assets, say land, doesn't look like it will make a difference. The policy implication immediately out of that: what else do you need? And we were arguing for better access to financial markets. And, a lot of this seemed to make sense in South Africa where, in many parts, if you had land, you can't go to a bank and borrow money. Now, many people see that that's a form of market failure, because if you've got an asset you're supposed to be able to go to a bank and say look, here's the surety you need, give me the money, and then I can buy seed, hire a tractor and plough my land and I'll grow food and I'll pay you back. But if that breaks down, then something's not working in your economy. This may seem not at all surprising to someone who is not an economist or to someone who is not trained as a neoclassical economist, but neoclassical economists believe very strongly that markets work. In South Africa we're talking about a market-led land reform. We assume that the market will work. Once people have got their land, everything else will fall into place. Once you start seeing that that's not happening then it starts to suggest that you might, you may think you've got a really great policy, a really progressive policy, but it doesn't have the desired result because you haven't dealt with the other problem that you've got. (Julian May, interview, 9 October 2003)*

The South African Participatory Poverty Assessment (SA-PPA) (1996–1997)

Following the first round of analysis of the PSLSD data, Prof May got involved in a number of other poverty-related research studies, two of which he regards as important developments in the emergence of the KIDS project. The first was the South African Participatory Poverty Assessment (SA-PPA) and, the second, the **Poverty and Inequality Report**.

According to Prof May, it was World Bank policy to follow quantitative with qualitative studies. In addition, at the time the Bank was particularly interested in the participatory methodology that had been developed by Robert Chambers at Sussex University. A collaborative process was initiated, involving non-governmental organisations, academic researchers and the erstwhile RDP Office. This resulted in the launch of the SA-PPA, for which Prof May was the principal investigator.

The primary aim of the SA-PPA “was to provide a fuller and more integrated understanding of poverty from the perspective of those who are poor and to fill the gaps which quantitative studies cannot readily explain” (May *et al* 1998:xii). The project was funded by the Dutch Trust Fund and the Overseas Development Administration, with technical support again from the World Bank. Anne Duncan of the World Bank approached Prof May and colleagues at Data Research Africa to administer a portion of the funds available to undertake the participatory research. Prof May described who was involved and how the process unfolded:

We were able to get Robert Chambers in as a technical advisor and we involved Francie Lund onto the steering committee. We involved Wilfred Wensel, who I think was at the Rural Foundation and was at SALDRU at that point, and we involved a University of Zululand researcher, Peter Ewang on the steering committee. PPA South Africa followed a different methodology from perhaps elsewhere. We invited NGOs to submit a proposal to use this methodology, which is very often used by NGOs, in their own areas, for their own purposes. We provided training in how to write up their results, which often they don't know how to do, and we provided training in how to extract policy implications. And then this team pulled the information together to generate a report. (Julian May, interview, 9 October 2003)

The Poverty and Inequality Report (1996–1998)

In 1995, the new South African government was approached by two international agencies with regard to further poverty-related work (May 1998:xii). The first was the World Bank, which wanted to undertake a collaborative poverty assessment. The second was the United Nations Development Programme (UNDP) with regard to the preparation of a Human Development Report for South Africa. In October 1995, the South African cabinet decided to commission researchers to develop a ‘poverty and inequality report’ (May 1998:xii). Prof Julian May put in a tender to write the report and, in April 1996, was awarded the tender by the RDP Office.

The objectives of the **Poverty and Inequality Report** included the following (May 1998:xii):

- ↳ To undertake a detailed analysis of poverty and inequality in South Africa
- ↳ To analyse current policy proposals for the reduction of poverty and inequality
- ↳ To analyse the adequacy of current plans to reduce poverty and inequality and possible barriers to their implementation, and
- ↳ To propose ongoing monitoring mechanisms to measure the impact of policies and programmes in the reduction of poverty and inequality.

The report involved compiling the work of a number of researchers who had undertaken poverty-related research in the 15 years prior. The preamble to the **Poverty and Inequality Report** (May 1998:xiii-ix) lists no less than 47 researchers upon whose work the report was based. The work of these researchers were compiled into five thematic chapters:

There were a number of lead researchers who were going to write the chapters. When we developed the tender, I went to a group of people that I had worked with and said would you like to participate in this? The team, again the names you would recognise – Chris Rogers into the spatial side, Aki Stavrou was my colleague from DRA who was an infrastructural specialist, Ingrid Woolard on the measurement of poverty, Patrick Bond on the macro economic analysis. [] I was the appointed person to interface with government and I was involved in several of the chapters and of the analysis: on the actual land reform and the poverty measurement, on conceptualising poverty and inequality in South Africa. (Julian May, interview, 9 October 2003)

In August 1996 Prof May convened an inception meeting in Pretoria with advisors from the World Bank, the UNDP and the Department for International Development (DFID), as well as a range of South African researchers who were to be invited to participate in the project. It is important to note that between April and August 1996, the RDP Office was closed and the Growth, Employment and Redistribution (GEAR) strategy was introduced. Thus, by the August workshop, the **Poverty and Inequality Report** project had been transferred to the Deputy President's office. According to Prof May, this caused quite a bit of confusion among the researchers, since the very basis of their interaction and agreement with government had shifted into unknown territory. The August 1996 workshop was therefore intended to be the opportunity for the South African researchers to plan what they were to do with the project.

This August workshop, and in particular, the heated debate between a World Bank and a UNDP advisor which took place, turned out to be very significant for the future emergence of the KIDS project. Prof May described these developments as follows:

Anne Duncan brought out a very strong World Bank team, most notably someone called Martin Ravalian. Martin is probably the best poverty researcher in the world. Very prolific. I've grown quite fond of him. At that point I didn't like him at all, he was absolutely opinionated. The UNDP also brought out a strong team. They brought out a whole lot of their auditors

who were involved in writing the Human Development Report for that year. Now, again, as you might know, the UNDP have a particular view of poverty which is very different from that of the World Bank. Ravalian believes that poverty is best measured by looking at a poverty line – so many Rand per month and whether you're above or below it. He was instrumental in developing these methodologies, he's applied them around the world, it's his baby. The UNDP say that income is an input into, it's not an outcome of poverty, it's an input, and what you should look at is life expectancy, adult literacy and other social indicators of development. And we had their team writing their report, the Human Development Report of that year, at this meeting. So, in addition to all this confusion amongst the South Africans, at one point there was this – in some ways very funny – moment of a UNDP person presenting the Human Development Index and then Ravalian taking him to pieces. To the complete confusion of the South Africans who, at that point, had no idea what on earth they were doing here or what was going on, what this blood fight between these two institutions was all about. (Julian May, interview, 9 October 2003)

According to Prof Julian May, at one of the tea breaks, he and Prof Michael Carter were discussing the feud taking place between the World Bank and UNDP advisors, when the “light” for the KIDS project “went on”. In particular, it became clear that a longitudinal study would enable them to measure poverty in terms of social and material capital (assets), rather than simply income, and that it would enable them to study the dynamics of poverty over time. Prof May described this development as follows:

Over tea we thought, we really need to think about poverty differently. This notion of income doesn't make any sense. We need to think about poverty as something that happens over a life time, that you can't see it at one moment in time, that someone might be here but they might be there next year because things go wrong. Or they might be in a bad position because it was a bad harvest, but actually they're rich. I mean all of our papers on 'combinations of assets don't work', what we really need here is not a poverty line that measures income. But, as economists, and recognising what we can measure as opposed to what others can measure, what we should be thinking about is poverty measured by assets. And assets is something you accumulate over a life time. (Julian May, interview, 9 October 2003)

Before proceeding with a description of what was to become the KIDS project, this section concludes with a brief discussion of the underlying rationale for using a panel study, and the associated advantages and disadvantages of longitudinal and cross-sectional surveys in understanding the dynamics of poverty.

The rationale for a longitudinal or panel study into poverty

The data generated through the PSLSD survey provided a critically important quantitative baseline of information about the extent of poverty in South Africa, and as such laid a useful foundation for further policy analysis and debate. As May et al (1999:3) put it: “The process of collecting these data and their subsequent analysis have been immensely useful

in both the capacity strengthening of the South African policy research community and ultimately in guiding South African policies since the first national elections.”

Despite the obvious significance and usefulness of the PSLSD data, it became clear to Prof May and Prof Carter that, as a cross-sectional study, the survey was “unable to address a variety of questions, particularly those concerning dynamic processes, important to policy researchers and practitioners” (May *et al* 1992:2). Rather, in order to explore the dynamics of poverty over time, a longitudinal study was required. For instance, it is possible to track changes, such as in income and expenditure, or poverty profiles, over a period of time, by conducting a number of cross-sectional surveys. This is done in the annual October Household Surveys conducted by Statistics South Africa, and the five-year Income and Expenditure Surveys (May *et al* 1999:4). What these cross-sectional surveys cannot tell us, however, is “the fate of individual households over the period” (May *et al* 1999:4):

*Suppose cross-sectional surveys at two points in time reveal that the poverty rate is the same in each period. This could be the result of the same households having been in poverty in 1993 and 1998. Alternatively, it may be that some households exited poverty over the period, while an equal number entered. Such distinctions, missed by cross-sectional surveys, might be very important in determining an effective policy response which may differ for chronic (the first case) versus transitory (the latter) poverty. (May *et al* 1999:4)*

In order to establish the dynamics of poverty at the household level, May *et al* (1999:4) argue that “a different type of survey is required in which the same households interviewed in the first period are re-interviewed in the subsequent survey.” These types of studies are referred to as longitudinal or panel studies. According to Carter & May (2001:1992), “Several panel data sets exist which have been used to analyze income mobility and poverty transitions.” Examples include “studies into the determinants of income mobility using the Cote d’Ivoire Living Standards Survey” or “the influence of family history on children’s well-being using the Panel Study of Income Dynamics in the United States of America” (*ibid*).

There are two distinct advantages to the longitudinal household survey (May *et al* 1999:5). The first is that it allows for the analysis of the dynamic behaviour of individual households and individuals. The second is that it enables the analyst to control for unobserved characteristics of households that may bias efforts to estimate causal relationships using only cross-sectional data. The major disadvantage of the longitudinal household surveys is that they “cease to be representative of the overall population after their first survey round” (May *et al* 1999:5). This representativeness decreases further in subsequent rounds owing to sample attrition. Therefore, panel data of this kind is unable to track poverty rates over time.

3.2 The KwaZulu–Natal Income Dynamics Study (KIDS) (1998–2001)

Initiation of and fund-raising for the project

Having realised that what they needed was a longitudinal data set, Prof Julian May and Prof Michael Carter started to think about what data could be used for this panel study.

They turned to the PSLSD data. The samples for the SALDRU study had been drawn to be provincially representative and KwaZulu-Natal was the only province whose boundaries had not changed after the instalment of the new government in 1994, and therefore remained representatively intact. In addition, Prof May was based in KwaZulu-Natal and had been involved in the original fieldwork in that province. They therefore decided to use the KwaZulu-Natal data from the SALDRU study as the basis for their panel data.

Prof May and Prof Carter then embarked upon almost a year-long process of trying to obtain funding for their proposed KIDS project. They started with a concept paper that was eventually developed into a fuller proposal. At first they approached the LAPC for funding. However, this was not forthcoming, primarily because of the massive budget required. As Prof May pointed out: “Panel work is very expensive, because you now have to find eighty specific households. It’s a lot more costly doing panel than cross-sectional.” (Interview, 9 October 2003) They also approached Anne Duncan at the World Bank but, although the Bank was willing to make a contribution, Prof May and Prof Carter opted not to take the funding because of the “high administrative and political burden” that came with it.¹³

At one point, Prof May and Prof Carter started to think that they would not be able to secure the funding they required. It then occurred to them, however, to pay a visit to Dr Lawrence Haddad at the International Food Policy Research Institute (IFPRI), who had been a member of a World Bank mission involved in the 1993 SALDRU survey. They made a presentation to Dr Haddad in 1997 and, in the end, managed to secure enough funding from different sources to go ahead with the project. In summary, financial support was provided by the three collaborating institutions, namely IFPRI, and the Universities of KwaZulu-Natal and Wisconsin. Additional financial support was obtained from the United States Agency for International Development (Office of Women in Development: Strengthening Development Policy through Gender Analysis; the BASIS/CRSP project at the University of Wisconsin-Madison; and, a University Partnership Grant); the Ford Foundation; a Centre for Science Development (now National Research Foundation) population studies grant to the University of Natal; and the Development Bank of Southern Africa. The project budget was in excess of R2 million.

During this time (1997), Prof May was still working on the **Poverty and Inequality Report** and also made a decision to leave the DRA and return to the then University of Natal.

¹³ Julian reported in the interview [9 October 2003] that his experiences in working on the **Poverty and Inequality Report** had made him “wary” of working with the World Bank. He said that the Bank had placed a “continual pull on where we wanted to take the **Poverty and Inequality Report**”; that the Bank had continuously put forward their views on where they wanted the analysis to go.

Aims and objectives of the KIDS survey

The objectives of the KIDS project included the following:¹⁴

- ⤵ To describe and explain changes in household welfare between 1993 and 1998
- ⤵ To describe the incidence and nature of shocks experienced by households and to explain why some households have coped with shocks better than others
- ⤵ To test different models of the household (unitary versus several types of collective models), and
- ⤵ To understand better the determinants of changes in household structure and formation.

The overall aims or purpose of the KIDS project are manifold, and are described differently in different contexts. On the one hand, for example, the web site of the South African Data Archive (SADA),¹⁵ which houses the KIDS dataset, describes the purpose of the KIDS study as “to collect hard statistical information about the conditions under which South Africans live in order to provide policy-makers with the data required for planning strategies to implement such goals as those outlined in the Government of National Unity’s Reconstruction and Development Programme (RDP) (1993 codebook).” This version emphasises the need to fill the caveat of quantitative data on the extent and rate of change of poverty in South Africa. It also emphasises that these data are to be used primarily to inform policy-making at the national government level.

On the other hand, when speaking to the researchers – in particular Prof Julian May – it becomes clear that there were also what one might term academic or theoretical aims, directly concerned with identifying and explaining the **dynamics** of poverty, and on establishing an appropriate methodology for measuring poverty, over time, econometrically (i.e. use of panel data).

A final aim of the KIDS project is to continue the tradition of building the capacity of young researchers in the field. This range of different aims and purposes is encapsulated in the following quote from the original proposal for KIDS that was submitted to IFPRI:

First, [the study] will explore the nature and severity of persistent poverty in South Africa. Second, using both household and intra-household analysis, it will explore coping and accumulation strategies in order to identify those circumstances and constraints which dynamically reproduce poverty. Work on both themes is intended to aid the design of policies, such as asset transfers and safety nets, which will enable the poor to break the cycle of self-reproducing poverty. As part of a continuing collaborative effort with [and] between the researchers and South African policy makers, dissemination of the results of this study are assured. In addition, the project will continue the principal investigators’ tradition of using research as a vehicle to enskill and train a new generation of young South African researchers and analysts. (Proposal for the KIDS project to IFPRI, September 1997, p2)

¹⁴ <http://www.ifpri.org/themes/mp17/safkzn2.htm>

¹⁵ <http://www.nrf.ac.za/sada/>

The KIDS survey design and implementation

The KIDS project was designed as a quantitative survey in which as many of the original households in KwaZulu-Natal that were surveyed during 1993 as part of the SALDRU survey, would be re-surveyed in 1998. The data from these two surveys would be combined to form a panel dataset. Although not part of the original project proposal, a qualitative research component was added to the overall design much further down the line, in order to try to answer some of the questions emerging from the analysis. This qualitative component is discussed under a separate heading (the “Socio-economic study of the Persistence of Poverty and Inequality”) later in this section. For now, the discussion centres on the survey component of the project.

In designing the second wave of KIDS, the researchers had a number of challenging problems to address. Prof Julian May highlighted some of these in an interview:

When you do a panel study, do you go back to the house or do you go back to the people? And if you go back to the people, which people? We had to make decisions about that. We were trying to, we wanted to try and understand more about the intra-household questions. So, who has assets, who doesn't? We needed to figure out how do you measure social capital? What are the appropriate tools to measure this funny asset that was now being talked about. We wanted to gather the anthropometric data, the weights and heights of children. We needed to get the resources, the equipment and resources and training to do that. (Julian May, interview, 9 October 2003)

The KwaZulu-Natal portion of the PSLSD sample contained 1558 households of all races. For the KIDS survey, the project team decided not to re-survey the white (112) and coloured (53) households again in 1998. The 1998 sample therefore included only the 1393 African and Indian households in the 1993 survey. The 1998 household questionnaire was very similar to the PSLSD questionnaire, but for a few important changes, including (May *et al* 1999:6):

- ◀ A greater focus on individual (as opposed to household) ownership of assets and control over their use
- ◀ An expanded emphasis on those individuals not living in the household, but economically linked to it, and
- ◀ Four new sections on economic shocks, social capital, assets brought to marriage, and household decision-making. Prof May explained how they intended to employ the concept of ‘social capital’ in the study:

By 1998 this notion of social capital had been developed in the literature, and we introduced ideas of how do networks, how does trust, how do political systems matter? Is this an asset that poor people can use, in addition to land and their knowledge and things like that. [] You can do two things. One, you can add them up and say this is the minimum level of assets that people need, if they don't have them they won't get out of poverty. The second is that you can then say these are the assets they do have – either

they might need more of them or they might need help in making them work better. (Julian May, interview, 9 October 2003)

Another key difference between the 1993 and 1998 surveys was that the latter focused on the 'core decision-maker' in the household, rather than the declared household head (as was the case in the 1993 survey). The 1998 survey attempted, where possible, to track the core decision-maker and his or her household if they had moved since 1993.

Because the 1993 survey sampled physical dwellings (and then built up households based on the set of people who lived in those dwellings), decisions had to be made about the definition of the unit that was to be reinterviewed in 1998. For each household in the 1993 survey, a set of core household members was identified based on age, economic activity and likely status and decision-making power within the household. The fieldwork protocol developed dictated that in the event that a 1993 household fractured (in the sense that core people split off into multiple household units), then all new household units would enter the 1998 survey. The study presented here can thus be seen as a random panel study of the households of 1993 core economic decision-makers. Note that this sample is NOT representative of the universe of 1998 core decision-makers as it obviously excludes (largely younger) individuals who were not core decision-makers in 1993. (Carter & May 2001:1993)

Box I: Selected KIDS findings

- The poverty headcount in KwaZulu-Natal (based on an expenditure-based poverty measure) increased from 26.8% in 1993 to 42.5% in 1998
- The average income shortfall of the poor (expressed as a percentage of the poverty line) increased from 27.1% to 33%

Poverty transitions (see below):

- 22% of households were poor in both 1993 and 1998
- 11% of households had moved out of poverty by 1998
- 19% of households had fallen into poverty between 1993 and 1998, and
- 47% of households were not poor in either year.

KIDS 1993-1998 Poverty Transition Matrix

	Poor in 1998	Non-poor in 1998
Poor in 1993	22% (chronic poor)	11% (got ahead)
Non-poor in 1993	19% (fell behind)	47% (never poor)

Source: Adato, Lund & Mhlongo (2003:2)

The 1998 fieldwork was undertaken in KwaZulu-Natal between March and June of 1998. Survey enumerators were employed to undertake the data collection and received training for two weeks prior to entering the field. Since the questionnaire took about three hours to complete, repeat visits were required to avoid respondent fatigue.

During the fieldwork for another project in 2001 the researchers discovered that a number of the clusters had been fabricated. They were therefore compelled to rework the original analysis of the data:

During related follow-up field research in May 2001 it was discovered that all the household interviews in two clusters had been fabricated in both 1993 and 1998. Concerned that the problem might have been more widespread, and to validate the remaining data, the team decided to carry out an extensive verification, visiting over one half of the clusters in the sample. Based on these visits, four other suspicious clusters were identified. Therefore all 146 households from the six presumably fabricated clusters are dropped in this analysis (and in the updated release of the data), leading to discrepancies between the figures concerning attrition reported here and those reported in previously published work, in particular, May et al. (2000). (Carter et al 2003:7)

Between June 1998 (when data collection was completed) and April 2000 when the data were released, the data was extensively checked and organised. The researchers had a very strong commitment to making sure that the data were placed in the public domain and, in April 2000, the two datasets (1993 and 1998)¹⁶ and their associated documents, were handed over to the South African Data Archive (SADA).¹⁷

We poured a fortune into the study eventually, far more than was originally budgeted as we tried to deal with policy issues. We'd all made the commitment that the data would go back into the public domain, as with SALDRU, with the idea that there was just so much data here that there was no way that we would ever, as a group of researchers, analyse it in any case. (Julian May, interview, 9 October 2003)

The Socio-Economic study of the Persistence of Poverty and Inequality (SEPII)

During the course of the 1998 KIDS survey, Prof Julian May and Prof Michael Carter had established a relationship with another research group in Peru, that was also engaged in research around poverty. According to Prof Francie Lund, it was this relationship and the proposed collaboration between the groups that sowed the seeds for the qualitative component. Prof Lund described the broad aims of the proposed collaboration as follows:

There was going to be a kind of historical project looking at political elites. There was going to be – on the South African side – further mining of the KIDS data. And then a qualitative component in both Peru and South Africa. (Francis Lund, interview, 14 June 2004)

¹⁶ The datasets are available in Stata 6.0 and SPSS for Windows and are accompanied by a coding book.

Carter et al 2003:10 describe the datasets in greater detail: "The 1993 materials include the original PSLSD data for KwaZulu-Natal only (with a small number of corrections based on a re-examination of some of the original questionnaires), the 1993 expanded codebook and questionnaires, and the Stata software programs used to calculate 1993 income and expenditure. [] The 1998 materials include the 1998 KIDS data, the 1998 expanded codebook and questionnaires, the Stata software programs used to calculate 1998 income and expenditures, and the 1998 fieldworker manual."

¹⁷ See the SADA web site (www.nrf.ac.za/sada/) for information pertaining to the KIDS dataset.

At the same time, the analysis of the KIDS data, as well as of the previous poverty studies, had raised a number of questions that could not be answered adequately by the quantitative data. The following two quotes describe this development as follows:

Although KIDS marked important progress in the study of poverty dynamics, the findings raised new questions. First, as with any survey data, there was good information on the nature of changes, but not always good explanations for them. Regressions suggested certain causal relationships, but these were still insufficient to understand the complexity of poverty dynamics. (Adato et al 2003:2)

I read somewhere, I think it was one of the people that was involved in developing the nuclear bomb gave up any further research because he said every time he generated one bomb, they had questions, that they needed two more bombs. It's been a bit like this in the sense that every time we've completed one exercise we think, ah, that's what we should have done. [] We don't always agree on ideas, we have different ideas about social capital, for example, and we have unanswered questions. We could see this what I call class-based mobility but we were curious about how those people who did manage to get out of poverty, succeed? Because, you know, we actually need to look at the success stories as well as the failures to understand what's causing poverty to persist in South Africa and we probably couldn't do this with quantitative data. We threw a lot of math at the data but there are limits, you've always got your error term and you don't know what's in your error term. And again, this was starting to come out at that time of using qualitative and quantitative methodologies in tandem, spoke to a number of researchers, wrote another proposal to do quite an interesting study – I don't know if this experiment is going to work but it's quite interesting – with Francie, to go back to a sub-sample of the KIDS households, fifty households, to use participatory methodologies, the mapping out of timelines and so forth, to understand what really happened between '93 and '98. This does several things: one, it says obviously one of the reasons that we might see these patterns is because we measured things wrong – either we measured where people were in '93 wrong or we measured where they were in 1998 wrong, what we're seeing here is not structure, it's just mistakes. And I've done enough quantitative research to know that it's a very [unclear] instrument. So, going back might give us some sense of whether our theorising and our math and our surveys actually are telling us the real story, a believable story. The second is that, at least Michael and myself are very doubtful that you can measure social capital by asking a bunch of questions and that you actually need qualitative methodologies to do this. (Julian May, interview, 9 October 2003)

These various factors culminated in the development of a qualitative component of the broader KIDS project, which Prof Francie Lund described as ultimately being “much greater than anyone originally thought it was going to be.” The project – the Socio-Economic study of the Persistence of Poverty and Inequality, or SEPPI – was initiated in 2001 and was led by Prof Lund at the School of Development Studies. SEPPI was a

collaboration between the University of Natal (Durban), the International Food Policy Research Institute, the University of Wisconsin-Madison, and the Catholic University of Peru. Funding was provided by the John D. and Catherine T. MacArthur Foundation.

According to Adato *et al* (2003:2), “The main purpose of SEPPI was to develop an understanding of the factors that led households to move into or out of poverty, to stay poor or remain non-poor, over time.” In the study, a sub-sample of the households surveyed in 1993 and 1998 were revisited, “in eight of the 62 KIDS study areas” (Adato *et al* 2003:3). It is important to note that the SEPPI project was not merely an adjunct to the KIDS project; instead, there was an iterative process between the qualitative data collection and analysis, and the analysis of the KIDS statistical data:

*The study combines socio-economic panel survey data with in-depth, semi-structured household and key informant interviews, group interviews, and observation. It also developed unique participatory methods to conduct qualitative household interviews, with multiple household members constructing visual family histories. Notably, qualitative methods were used to delve underneath apparent relationships derived from quantitative statistics and regressions, in order to understand what the numbers were measuring or missing. Iterative analysis of the longitudinal quantitative data and retrospective qualitative data enabled greater analytical insight than is normally available from either type of data alone. In addition, visual methods were developed to explore the composition of “the household”, and to gather data from and about household members that may be missed in surveys. The study focused on changes in the poverty status of households, primarily through the periods 1993 to 1998. The qualitative research also traced some changes through 2001. (Adato *et al* 2003:1)*

The fieldwork for the SEPPI project was undertaken in both Peru and South Africa during 2001. In 2002, the data was transcribed and analysed, and researchers began to publish articles on the findings.

The KIDS second wave project team

It has already been established that the 1998 survey was a collaborative undertaking between Prof Julian May, Prof Michael Carter and Dr Lawrence Haddad. Each of these project leaders had at least one younger researcher working under them. Two of these, who played a significant role in the KIDS project, were Ben Roberts and John Maluccio. The qualitative component of the KIDS project (SEPPI) was led by Prof Francie Lund and Phakama Mhlongo (University of KwaZulu-Natal) and Michelle Adato of IFPRI, with support provided by three research assistants. (See Appendix I for brief descriptions of the professional backgrounds and research interests of the primary researchers.)

Other organisations and individuals also played a role in the project. These included:

- ◀ SALDRU gave permission for the 1993 data to be redistributed, and provided other assistance to the project team
- ◀ Data Research Africa carried out the fieldwork (Aki Stavrou, Faith Slu Hlongwa and Ben Roberts)

- ⤵ Policy and Praxis was responsible for data entry (Juby Govender, Malani Govender, Priya Gayadeen and Stacey von Schalkwyk)
- ⤵ Ingrid Woolard of the University of Port Elizabeth undertook the task of constructing the aggregate measures, and
- ⤵ Justine Barnes, Catherine Cross, Deon Filmer, Chris Gibson and Duncan Thomas contributed their time and ideas.

3.3 The KIDS third wave (2004)

Prof Julian May jokes about how the idea for conducting a ‘third wave’ of the KIDS project emerged at the top of a Peruvian mountain, about 4 000 metres above sea-level (by implication: where the air is very thin and one’s brain is not functioning very well!). Seriously, however, in the course of analysing both the quantitative and qualitative data emerging from the second wave of KIDS, the researchers had realised two important things: firstly, that despite the apparent value of their longitudinal data, it was becoming increasingly important to take into account the impact of HIV/AIDS on the dynamics of poverty; second, that government would only really benefit – in terms of monitoring the impact of poverty alleviation strategies – from an even longer time period of data collection. Prof May described these developments as follows:

At some point, my colleagues put it to me that we should do a third wave, to which I had said, I cannot bear it, I cannot do this! [] But the argument was twofold: one, there is no other series of information that can tell us what happened before AIDS to households and now with AIDS, ‘cause we will see households where there have been deaths. The second is, it is very difficult for any government department to say what impact their policies have because almost certainly any government department that tries to monitor what’s happened to people will see things getting worse and that might not be because their policies are failing – things could be getting much much worse if they didn’t have these policies. But we can’t take into account an AIDS impact as opposed to a policy impact. The last thing is this question of asset accumulation, I mean we only had a five-year time horizon and we’re not getting a very pretty picture, but perhaps things have changed. Perhaps after another five years of these policies, after the adjustment period when huge numbers of jobs were lost, perhaps we might start seeing a better story emerging. We might be able to see how to make a better story emerge. So, as I say, over 4000 metres of height, I was persuaded that we need to write another proposal. [laughter]. (Julian May, interview, 9 October 2003)

Again, Prof May, Prof Carter and their colleagues developed a new proposal. The goal of the third wave is described in the proposal as follows:

[] to improve evidence based policy making for pro-poor policy through the analysis of these KIDS data and by placing these data into the public domain for analysis by the wider research community in South Africa and elsewhere. (Proposal for the third wave of KIDS, p6)

As can be seen from the above quote, the researchers' intention to make the data and research findings available for direct uptake and utilisation, particularly for the advancement of knowledge and to inform policy development, is very explicit in the proposal. Prof May explained how he understood the Department of Social Development's interest in KIDS third wave as follows:

The light that went on in their head that we can assess the impact of the Child Support Grant, introduced in 1998, take up in KwaZulu-Natal, this is how we can assess the impact now. Anything else they have to do, they'd have to start now and they can only get an impact assessment out in a couple of years' time. You can't really do an impact assessment on cross-sectional data. So that's their big, I think, interest in this. I think they also bought into the HIV arm of it. We need to know what is happening to households as people die. (Julian May, interview, 9 October 2003)

This project goal was translated into the following research questions (Proposal for the third wave of KIDS, p7):

- ◀ What are the pathways into and out of poverty including accumulation effects, life-cycle changes and social capital?
- ◀ What are the micro-economic barriers to mobility out of poverty in South Africa and how do these operate to produce poverty traps?
- ◀ What have been the long-term effects and impacts of government policies on poverty reduction, especially policies relating to social security grants, access to services and employment?
- ◀ What are the social and economic costs of the HIV/AIDS epidemic in terms of the impact on household livelihoods, the burden of care and coping strategies? and
- ◀ What are the appropriate methodologies for the analysis of persistent poverty and what is their application to policy analysis and to the monitoring and evaluation of government policy?

The survey design involved re-interviewing the 1100 households that were surveyed in 1998, as well as approximately 500 additional households which would have been established since then. The 1998 survey instrument was extended to include the collection of information "concerning the impact of social security grants, particularly the Child Support Grant (CSG), the impact of HIV/AIDS on poverty and long term poverty dynamics" (Proposal for the third wave of KIDS, p5). The survey data was to be complemented by qualitative data "gathered at a community and household level concerning social networks and processes, as well as by secondary data showing population characteristics, access to services and geo-referenced facilities and boundaries" (Proposal for the third wave of KIDS, p6). The fieldwork for the third wave took place between March and June 2004. The research team anticipates that the dataset will be available for use in the public domain by the end of the first quarter in 2005.

The third wave of KIDS is funded by a variety of organisations, including the South African national Department of Social Development, via a grant from the United Kingdom's Department for International Development (DFID), the United States Agency for

International Development (USAID), the Mellon Foundation, the National Research Foundation in South Africa, and the Norwegian Research Foundation. However, as Prof Julian May explained, it was not easy trying to find money for this kind of research and for this kind of budget:

We tried the usual culprits but they weren't interested in South Africa as a middle-income country. It's a lot harder to get money now than it was then. [] None of these people actually want to fund this kind of research. It's now even more expensive to do this – now I think we're up to over, just on R2 million to collect the data. (Julian May, interview, 9 October 2003)

The researchers also discovered that while some of these agencies were interested in contributing to the project funding, they were hesitant in doing so until other parties – and in particular the South African government – made financial commitments too. For example, Prof May reported that Dr Lawrence Haddad approached DFID UK about possible funding. Prof May explains what happened next:

[DFID UK] said if DFID South Africa put money in we'll put money in. I tried DFID South Africa. They said, if the government sponsors this, we'll put money in. So we've wound up now with the Department of Social Development who have bought into this idea. (Julian May, interview, 9 October 2003)

The core research team of Prof May¹⁸, Prof Carter and Dr Haddad on the survey component, and Prof Francie Lund and Michelle Adato on the qualitative side, remains.¹⁹ Over and above this, the team has expanded quite considerably. For instance, according to the proposal (p 11), “The Department of Social Development is the government department responsible for oversight of the KIDS third wave. The Monitoring and Evaluation directorate has direct responsibility for this project, and the milestones and deliverables that will follow.” There is also involvement by the South African National Treasury, the Centre for Population Studies at the London School of Hygiene and Tropical Medicine (Ian Timaeus), and the Norwegian Institute of Urban and Regional Studies, amongst others. In addition, the project team intends to continue their tradition of bringing students into the project in order to build their capacity in the field. Prof May described the participants in the third wave as follows:

KIDS remains the original IFPRI-Wisconsin-Durban team, now with [Dept of Social Development] involved and the London people involved as demographers. We've also funded a new round of qualitative research which is IFPRI plus someone in a Norwegian institute. So the qualitative continues, the team is slightly modified to bring in some new expertise. We've now set up a programme here, a formal internship programme where there are, each year there's a group of people coming into the Masters programme, like Ben Roberts, who will receive training, become researchers. At the moment there are three young researchers that will be involved in the KIDS study. So we've got another group now, the same idea in that trying to

¹⁸ Prof May is responsible for the overall project management.

¹⁹ John Maluccio, who was directly involved in the KIDS second wave, is partly involved in the third wave as a consultant to the team, particularly around the ideas and lessons learnt during the 1998 study.

reproduce a new group of researchers who are familiar with these kinds of data. And we'll see what happens. (Julian May, interview, 9 October 2003)

With the above narrative description in mind, the following two sections consider the modes and contexts of knowledge production and utilisation around the KIDS projects.

4 Mode of knowledge production

4.1 The collaborative research process

Both the second and third waves of the KIDS project have been highly collaborative, and thereby interdisciplinary, endeavours. The primary collaboration has been between Prof Julian May and Prof Michael Carter, and in a more peripheral way, Dr Lawrence Haddad. According to Dr Haddad, “KIDS is an excellent initiative, combining South African institutions with a high powered academic institution in the US (to generate academic public goods) and a policy think tank (IFPRI) to generate international policy public goods.” (Lawrence Haddad, e-mail) Other collaborators included Prof Francie Lund (School of Development Studies) and Michelle Adato (IFPRI), who worked on the qualitative component. There were memorandums of agreement and sub-contracts between the three institutions but, according to Dr Haddad, “most of the collaboration was guided by informal networks of trust built up over the years.” (Lawrence Haddad, e-mail)

It appears that each collaborator undertakes tasks that relate to his or her disciplinary backgrounds, research interests and personal strengths. For instance, Prof Carter took a large responsibility for the statistical analyses. Prof May, on the other hand, played an important role in the networking around the KIDS project – both in terms of raising funds for the various projects and rounds of analysis, and in disseminating the findings and making sure that they reach the ‘right’ people.²⁰

Prof Carter described the ‘division of labour’ between himself and Prof May as follows:

I think a lot of the pre-ideas and insights that Julian and I have worked on are things that we sort of talked about on aeroplanes and tea breaks, and things like that. Doing research is sort of the conceptual part, I guess. And that I think has been quite collaborative. Beyond that, I think I would say that my technical and statistical training and experience is significantly more than Julian’s, so I think it would be fair to say that I’ve brought more to the table in terms of, okay, so there’s an idea, how do we actually do something with that in a numbers sense? Over the years the different kind of, you know, funny things that we’ve estimated and measured – I’ve done those, let’s call it the technical work on it. I view myself as having been quite

²⁰ In the normal course of his work, Prof May places an enormous emphasis on producing research that can inform policy. He described his early influences which shaped this orientation as follows: *My mentor was someone called Jill Natrass, who established this place, the economics part of this organisation in about 1981. I was an economics Honours student at that stage. Jill enticed me from doing a Masters in economics to come over here and do a Masters in development studies. Jill was heavily involved in policy analysis, I mean she wasn’t, definitely was not an armchair academic, was highly respected by very diverse people about her views on development policy. So that in a sense shaped my thinking. Jill was also, she was the kind of researcher who said you can’t sit and work in front of a computer if you want to get involved in policy. And myself and a sociologist that had joined the Department spent a year in the Transkei, in the valley, this was leading onto the Carnegie conference. So, you know, I’ve got the usual white suburban background, okay, to be exposed to gruelling poverty for the first time in my life, I think, no, I don’t think I would want to do this job if it only led to publications and reports, I can’t possibly imagine doing that. (Julian May, interview, 9 October 2003)*

*extensively involved in the longer-term research agenda that we had going.
(Michael Carter, interview, 9 June 2004)*

In general, Lawrence Haddad was involved in the survey design, the pre-testing of the questionnaire and in the implementation of the project. These boundaries were not always this clear, however, and the researchers often played many of these roles.

There were also a number of students involved in various aspects of the projects over the years, as well as involvement by agencies such as the World Bank and, in the KIDS third wave, individuals from other research institutes and foundations. According to Prof May, the success of the KIDS projects has depended to a large extent on this broad collaboration:

This study has been an international collaboration with overseas academics and a research institution/think tank. This has facilitated peer-on-peer learning, both by myself and for the South African students that have been involved. This also assisted in achieving a policy impact in South Africa owing to the status of the international researchers who were involved. Finally, this mode of working has helped the study reach an international audience of policy-makers/shapers. (Julian May, questionnaire)

4.2 Different research modes and methods

The second and third waves of KIDS differed in the predominant type of research. The 1998 KIDS project is an example of strategic research insofar as the researchers saw the need for a particular kind of poverty analysis (and hence data) which could fruitfully contribute to policy development around poverty alleviation in South Africa. Prof May described the KIDS second wave as ‘blue sky’ research.

The third wave, on the other hand, is more applied research, given that it contains a focus on the Child Support Grant. To a large extent, these different orientations to the research process are reflected in the extent to which external stakeholders and potential users were involved in the conceptualisation of the research and its implementation. Michael Carter commented on this as follows:

*For the third wave, we actually have people from [the Department of] Social Development for sure, and maybe another government agency or two have been in on meetings, talking about the survey and the questions and the design and the types of data and those kinds of things. We never had that before and I view that as kind of a positive reflection of the fact that we took the KIDS 2 data to people, to the government people as much as we did, and got them as interested in it as we did. And again I think Julian deserves an especially large dose of the credit for having done that.
(Michael Carter, interview, 9 June 2004)*

These different orientations are also evident in the form of the research proposal: while the proposal for the KIDS second wave was referred to as a “research proposal”, that for the third wave is referred to as a “business plan”.

You will notice a huge difference between these two documents, the KIDS study and the KIDS 3 study. This top one [1998 proposal] has a

whole lot of theory and a whole lot of our ideas in it, the bottom one [KIDS 3 study] has a risk analysis. And there's this thing here [project management document], it's got one of these attached to it. We never did that for [KIDS 2]. [] That's working with the policy-makers. When we failed to get outside funding for the third wave of KIDS, Lawrence made contact with DFID, who said you're going to have to go to DFID South Africa. As soon as DFID South Africa said you're going to have to go to the government, I said to Lawrence, this is going to be hard. This is very different from what we did [in KIDS 1998]. This isn't us saying well, we have very good reasons why we want to do this, and we'll do it and then we'll figure out what papers are really important as we go along, and we'll, you know, we'll get an idea about what the budget is but we'll throw more money in if we need to throw more money in. That's gone. As soon as it turned into that kind of project, the requirements of the people, of the other partners, are so difficult, you are compelled to do that. (Julian May, interview, 10 October 2003)

Both the KIDS projects employed a complementary mix of both quantitative (survey) research and qualitative and participatory approaches. These two methodologies worked together to raise questions and seek solutions and, according to the researchers, this was an invaluable combination.

4.3 Research outputs and dissemination strategies

The research outputs of the KIDS project are primarily of an academic nature and include articles in scientific and popular journals, book chapters, a contract report, conference proceedings and input into policy documents. Some of these academic outputs are based on the analysis of the KIDS data, while others focus on the theoretical and methodological developments that emerged in the KIDS project. In some respects it is difficult to draw a boundary around the KIDS-related publications given that the theoretical ideas which the researchers developed – both before and during the KIDS project – have found their way into publications which do not have a specific focus on the KIDS project. Appendix 2 provides a selected list of publications, produced by the various members of the research team, which focus explicitly on the KIDS data, theory and/or method.

The KIDS dataset itself is one of the major outputs of the project. As was highlighted earlier in this report, the 1998 dataset was put into the public domain in April 2000, and in South Africa is housed by the South African Data Archive (see box below). The KIDS dataset is also housed on the IFPRI web site and by the World Bank's Africa Databank.²¹ This serves as an important form of broad dissemination which appears to be very effective (see Section 5.1).

²¹ <http://www4.worldbank.org/afri/poverty/databank/>.

Box 2: The South African Data Archive (SADA)

SADA, based at the National Research Foundation, serves as a broker between a range of data providers (for example, statistical agencies, government departments, opinion and market research companies and academic institutions) and the research community.

Objectives of SADA

- To acquire and catalogue survey data and related information
- To preserve such data against technological obsolescence and physical damage
- To provide originators or depositors of data with necessary information in order to ensure high standards of data documentation
- To re-disseminate such information for use by other researchers, for re-analysis of data, longitudinal and comparative studies, research training, teaching and policy-making decision purposes
- To formulate policies for the scope and content of data and data preservation, and
- To promote the optimal use of data.

SADA's data holdings are from a wide range of areas, such as censuses and household surveys, Omnibus and international studies, demographic and health-related studies, substance abuse, crime, income and poverty, inter-group relations, labour and business, education and training, and political perceptions and attitudes.

Source: <http://www.nrf.ac.za/sada/introduction.html>

The researchers also disseminate the data and findings of the KIDS project via their own *informal networks*. For example, Ben Roberts reported that owing to his close association with the KIDS project over the years, he has continued to play a role in disseminating the KIDS data and findings, and answering requests for the data from other academics.

Beyond these traditional academic routes for dissemination, the research team – but in particular Prof May – puts considerable effort into disseminating the lessons learnt from the analysis of the data and potential applications for policy development, to potential users in policy and academic circles, both locally and internationally. *Workshops and presentations* were made, amongst others, to the National²² and KwaZulu-Natal Treasuries, the national Department of Agriculture, the national and provincial Department of Social Development, the Premier of KwaZulu-Natal, and the provincial Statistics South Africa. Results have also been presented to the World Bank, UNDP and DFID during workshops on country assistance programmes, to non-governmental organisations such as Africare and Oxfam, and at several Trade and Industrial Policy conferences. The researchers also participate in different boards, committees and councils, such as Prof May's involvement in the Statistics Council. These instances present further opportunities for the researchers to talk about their research, and make input based on empirical evidence and past experience.

The focus of the researchers' interactions with policy-makers in national government is at least threefold: to disseminate the findings of the research; to persuade the government of a particular approach to the measurement and monitoring of poverty; and, to inform the

²² In one case, the KIDS researchers initiated the workshop, while in a second, they were approached directly by the Treasury.

government of the ways in which data such as that of the KIDS project can fruitfully benefit the policy process. Mr Roberts described his view of what Prof May is attempting to achieve in his presentations to the policy-makers:

I think the one area where we really, and it's something Julian places a very strong emphasis on, is trying to reach the ears of the decision-makers, particularly in the South African government. You know, it's something that he's been pushing on since the early days of KIDS. Even as recent as a couple of months ago he made a presentation to the National Treasury about the kind of impact that, the extent to which KIDS-type information can inform policy-making. [] I think he's trying to get people, and particularly decision-makers to appreciate the fact that poverty is highly differentiated and is highly fluid and that what we need to be able to do is have information like KIDS to be able to help design and direct appropriate interventions. And recognising that different groups are going to be vulnerable and at risk at different times. (Ben Roberts, interview)

In this sense the researchers have a kind of 'meta consciousness' about the utilisation of their research. As indicated in Section 5.1, some of the researchers actually keep track of and report on the nature and extent of utilisation, and have written reflective pieces on the lessons learnt about moving poverty research into the policy domain.²³

Finally, the qualitative component of the KIDS projects has facilitated further interaction with and information dissemination to the communities involved in the study. The research team compiled an information pack of relevant government services that was disseminated within the communities within which the researchers had been working:

What we tried to do is essentially form an information pack with what, this is what government offers, and we'll do it again with the KIDS study. This is what government offers. So we went to the various departments and said, what user-friendly information packs do you have? How to get a grant, how to do whatever. (Julian May, interview, 9 October 2003)

The team is intending to continue this practice in the third wave of KIDS, but this time also including information on HIV/AIDS, where to get counselling, what services are available, etc. Prof May did not feel that it was appropriate for researchers or enumerators to slip into a counselling role, not least because it was dangerous: "Rather provide the information about how someone can seek counselling."

I'm doubtful about this notion that many researchers have and that, what we'll do is we'll take the report back to the community, because I think often the information is not actually usable at a community level, and what you take back is not necessarily something that is appropriate. But I do think, as

²³ Examples include: May J & Attwood H (1998) *'Kicking down doors and lighting fires: The South African PPA.'* In: J Holland & J Blackburn (eds), *Whose Voice? Participatory Research and Policy Change*. London: IT publications, pp119-130; May J (2003) *"Talking to the Finance Minister about poverty": Pro-poor policy and the political economy of information*. Paper prepared for the Conference on Chronic Poverty, Chronic Poverty Research Centre, University of Manchester, 8-10 April, United Kingdom; and, Carter MR (1996) *'Intellectual openings and policy closures: Disequilibria in contemporary development economics.'* Published as Chapter 4 in *Development Knowledge and the Social Sciences*, Fred Cooper and Randy Packard (eds). University of California Press.

a researcher, you've got to respond to, you've got to talk about what you've been interviewing and [unclear] I've done presentations, and we found it quite useful when we went back on the qualitative study to say to people, here is the list of people that we've spoken to about you, and it goes from the Deputy – now the President – through to the Premier of KwaZulu-Natal, through to government. You know whenever we do public presentations, certainly whenever I do public presentations, I will talk about this study, those different elements and I see that as a way of doing justice to the people who have given us their time [communities participating in the research]. (Julian May, interview, 9 October 2003)

4.4 Advancing knowledge and theory about the dynamics of poverty in South Africa

The detailed narrative of the background to and the unfolding of the various KIDS projects (Section 3) highlighted some of the theoretical and empirical questions and ideas which both informed and grew out of the projects. Key amongst these was the ability to demonstrate empirically the transitory nature of poverty, and further develop theory around asset accumulation, social capital and the link between these and the workings of the broader economy. The following quote is an example of one of the theoretical developments which emerged during the first few years of Prof May and Prof Carter's collaboration; namely, the notion of the "Micawber Threshold":

In terms of the knowledge creation, the big step for me was the second article that we got into World Development [journal] which used, I think, some quite innovative ideas. [] That paper then, I think, set out this notion of structured, of poverty traps, of class-based mobility, it depended where you were in 1993 where you would wind up in 1998. I think it starts to identify, you can start to see these market failures taking place for a group of people. Michael calls it, I think it's a really nice comment, notion, he calls it the 'Micawber Threshold'. [] Essentially from David Copperfield where Mr Micawber was always making a plan, he always had a scheme, he was always trying something but it never worked. And we said that there's a Micawber Threshold, that if you're below this poverty, this threshold, you can work as hard as you like, you can scrimp as hard as you like, but you can't get out of poverty. There's always negative things happening to you, there's shocks that are happening to you, your resources don't work. And it tied in very nicely with, why I had that long diversion about the PPA, some of these ideas came out of the PPA because when we read people's narratives, although I had had that experience in 1981 and although I'd been involved in poverty for such a long time, just thinking how hard it is to be poor, that nothing ever works, nothing ever nice happens to you. And so, you know, it's not surprising that there's such a thing as a 'Micawber Threshold' when you say, I can't take a chance because if the crop fails, the kids die. It's not like if the crops fail, I'll borrow money from my neighbour or I'll do without the VCR this year. It's really big decisions that people have to make. And so I think that was quite an important thing to come out of that, for me anyway, to have come out of that study and I think we broke some nice theoretical ground there. (Julian May, interview, 9 October 2003)

5 Mode of knowledge utilisation

The potential for utilisation is implicit in the aims of both the 1998 and 2004 KIDS surveys, as well as the qualitative components of these projects. In the following examples of utilisation, the specific focus is on uptake and application of the 1998 project, given that the 2004 third wave was still in progress at the time of writing (June to August 2004).

The four aims of the 1998 survey (see Section 3.2) included

- i) filling the data gap
- ii) informing policy
- iii) advancing theory and measurement of poverty, and
- iv) building the capacity of younger researchers in the field.

To different degrees, these aims have been fulfilled and some form of utilisation has taken place. This has included the use of the KIDS data and theory by other academics; the use of the findings of the research to inform policy; and, knowledge transfer to young researchers and users. These are discussed in greater detail below.

5.1 Use of the KIDS data, findings and theoretical underpinnings for further research

Perhaps the most common and explicit form of utilisation that has emerged from the KIDS projects is the use of the raw data by other academics. If you type “KwaZulu-Natal Income Dynamics Study” into an internet search engine such as Google, numerous examples of the further analysis of the KIDS data, in diverse contexts and organisations locally and internationally, are listed in the results. According to Dr Haddad, by August 2004 there had been 317 requests for the KIDS dataset housed on the IFPRI web site (see Box 3); the majority from students, followed by professors/researchers and government officials.

Box 3: Requests of the KIDS Dataset by Country (as at 4/8/2004)

Australia	4	Iran	4	Philippines	3	Cameroon	3
Italy	7	Singapore	2	Canada	10	Japan	13
South Africa	33	Ethiopia	3	Kenya	3	Tanzania	6
Finland	2	Malawi	3	Tunisia	2	France	10
Mexico	3	United Kingdom	26	Germany	8	Mozambique	2
United States	92	Ghana	4	Netherlands	3	Vietnam	2
India	11	Nigeria	44	Zimbabwe	2	Indonesia	4
Pakistan	8						

Source: Information provided by Dr Haddad.

A year after the KIDS 1998 dataset had been placed in the public domain (i.e. in 2001), Prof Julian May and Mr Ben Roberts did a scan of the research literature to identify who had been using the data for their own analyses, and what kinds of research topics the data were being used for. The results of this scan were published the same year in an article by

Prof May and Mr Roberts in the journal *Social Dynamics*²⁴ and showed that "... in the relatively short length of time [the KIDS data] has been placed in the public domain [it] has prompted research on a range of critical social policy questions" (May & Roberts 2001:108). The research projects identified focussed on the following issues: fluid household boundaries, asset accumulation, effect of shocks, inter-household resource allocation, employment and earnings dynamics, social capital, demographic transitions, and international comparisons (May & Roberts 2001:108-111) (see Box 4). The authors conclude by pointing to the potential for the KIDS projects – and particularly the third wave in 2004 – in informing policy development:

As the growing body of research summarised above begins to illustrate, the KIDS database is also a potentially rich resource suitable to a wide range of other research and policy questions. As with the original PSLSD study, it is to be hoped that the data will serve as a building block in redressing the inherited paucity of information available for policy making in South Africa. A third wave of data collection would improve both the reliability of the analysis already undertaken and open new opportunities for other analysis. (May & Roberts 2001:114)

Box 4: Examples of research projects drawing on the KIDS data or findings

- Alderman H, Behrman JR, Kohler H-P, Maluccio JA & Watkins SC (2000) **Attrition in longitudinal household survey data: Some tests for three developing country samples**. IFPRI Discussion Paper 96. Washington DC: International Food Policy Research Institute
- Keswell M (2000) **Labour market dynamics in South Africa: Evidence from KwaZulu-Natal province**. Paper presented at the Trade and Industrial Policy Secretariat Annual Forum, 18-20 September 2000, Johannesburg
- Maitra P & Ray R (2000) **Intra household resource allocation and their impact on expenditure patterns: Comparative evidence from South Africa and Pakistan**. Discussion Paper 2000-09. Tasmania: School of Economics, University of Tasmania
- Manzini N (2000) **The impact of women's education on fertility in KwaZulu-Natal, 1993-1998**. Unpublished mimeograph, University of Natal, Durban
- Stewart R (1999) **Negative economic shocks and changes in the composition and structure of poor, rural, African households in KwaZulu-Natal, 1993-1998**. Unpublished mimeograph, University of Natal, Durban

Source: May & Roberts (2001)

Four Masters and two PhD theses have been produced thus far based on the KIDS data. For example, Mr Ben Roberts, who was involved in the 1998 survey fieldwork, used the raw data for his Masters research. In fact, his Masters focus was one and the same as that of the KIDS project insofar as he was investigating the dynamic nature of poverty, and differentiating the policy needs for different types of poverty.²⁵

²⁴ May J & Roberts B (2001) 'Panel data and policy analysis in South Africa: Taking a long view.' *Social Dynamics*, 27(1):96-119

²⁵ Ben Roberts' Masters thesis was entitled: "Chronic and transitory poverty in KwaZulu-Natal."

But what is it about the KIDS data that gives it such enormous scope in terms of utilisation, and what is its particular value? According to Mr Ben Roberts, the KIDS project was the first major panel study at the time with an emphasis on poverty dynamics. In addition, the timing of the SALDRU study – on the eve of the democratic elections in 1994 – provides a very useful benchmark to gauge progress.

Since the KIDS project, there have been a number of other panel studies conducted in South Africa. In this sense, the KIDS panel forms part of a growing foundation of data on poverty. However, the fact remains that the KIDS project only includes data for KwaZulu-Natal, and for the African and Indian populations within the province, which limits the analysis of the dynamics of poverty to a particular region. May & Roberts (2001:114) argue, therefore, that “... there is a need to give serious consideration to the establishment of a national panel” in South Africa.

As was alluded to in Section 4.3, the main theoretical and methodological developments that emanated from the KIDS project have found their way into a number of publications and postgraduate programmes. The theoretical ideas have also been used to inform further research in other areas. For example, Mr Ben Roberts reported that he draws on the data and theoretical underpinnings of the KIDS study “extensively” in his current work as a researcher at the Human Sciences Research Council.

I just recently completed a project for the British [Department for International Development]. They actually asked us to do a scoping exercise in Southern Africa, visiting the six countries that were affected by the recent humanitarian crisis, and look at issues around social protection and food security to inform their regional vulnerability and hunger programme that they want to establish. So the actual conceptual underpinnings of social protection along very much the lines of the KIDS work, trying to say that there are very many different dimensions to poverty that need to be accommodated in policy-making. (Ben Roberts, interview)

5.2 Informing policy development

Given that one of the primary aims of the KIDS project is to inform policy development, it is interesting to explore the extent to which this has occurred. The researchers mentioned the following instances of uptake within policy and government circles, of which they are aware:

- ⤷ Research results were used by the Minister of Finance in a recent cabinet *legotla*
- ⤷ Research results were used by researchers involved in the Taylor Commission on social security grants
- ⤷ The methodology is being considered by the Department of Social Development for monitoring the impact of social security grants, and
- ⤷ The findings have found their way into government documents, and particularly those of the National Treasury since, as Mr Roberts explained, “... that’s the main department that Julian’s been targeting, mainly because they have a clear role in poverty monitoring.” (Ben Roberts, interview) Two specific examples provided by

Mr Roberts include explicit reference to the KIDS data in the National Budget Review (2001) of social welfare expenditure (see Box 5), as well as a section written by Ingrid Woolard and colleagues in a South African Reserve Bank document²⁶, in which the KIDS data is employed in an analysis of income mobility and household dynamics.

Box 5: Reference to the KIDS data in the National Budget Review 2001 on the formal and informal labour markets in KwaZulu-Natal

“Recent analysis of the KwaZulu-Natal Income Dynamics Surveys suggests that the informal sector appears to be larger and more economically vibrant than is often thought. A significant number of prime working-aged individuals (25 to 54 years) who were in the informal sector in 1993 and 1998 experienced sizeable real gains in income over time. Real increases in income even extended to many of those who moved from employment in the formal to the informal sector (45 per cent), and was widespread across workers with different education levels. Studies on informal sectors in Latin American economies show that the combination of costly regulation and weak enforcement induce businesses to move from the formal to the informal sector. This has a number of negative consequences for the economy, particularly a reduction in the tax base in the formal sector. Policies to induce firms and individuals to move back into the formal sector would facilitate a progression for individuals from unemployment, to work in the informal sector, to employment in an expanding formal sector.”

Does research dissemination equal policy impact?

Beyond this evidence of the use of KIDS data or findings in policy and other government documents, all of the researchers commented on the difficulties associated with assessing the actual **policy impact** of the research. For example, Prof May observed that it is difficult to measure the policy impact that projects like KIDS can or do have, in part because the policy impact might take years to emerge, but also because the ‘policy messages’ are coming from quite a diverse group of scholars, working independently on analysing and interpreting the data:

So it’s hard to say where its policy impact, where it happens, because there are a lot of groups that are digging into the information. Some of it at a national level, some of it I think has international implications in terms of thinking about the dynamics of poverty. (Julian May, interview, 9 October 2003)

Mr Ben Roberts also highlighted the lengthy time that it takes for research to really impact on policy, but suggested that there is evidence of some form of uptake by the South African government:

Policy impact is something that takes a long time to bring about. In many cases, it’s trying to bring about something of a normative shift, trying to say well you want to move much more towards a culture of evidence-based

²⁶ Woolard I, Klasen S & Leibbrandt M (2002) ‘Income mobility and household dynamics in South Africa: The case of KwaZulu-Natal.’ In: **Labour Markets and Social Frontiers**, No. 2, October 2002, pp5-11. South African Reserve Bank.

policy-making. The results of studies like KIDS inform the actual content of policies. I think that's something that doesn't happen over night. That takes years and years to bring about. And I think that National Treasury have been very proactive and receptive to KIDS and we've had quite a number of presentations. [] The flow of information [to the policy-makers] is certainly there; the extent to which it is actually informing policy – it's probably a little slower in happening. But we are seeing signs that the message is going through. (Ben Roberts, interview)

Reflecting on the situation in the United States, Dr Maluccio commented that “Important surveys in the U.S. often take years to really begin to influence policy, because it can take that long for a body of research around them to form and be agreed upon.” (John Maluccio, e-mail) This points to the fact that there are competing ideas about the causes and measurement of poverty²⁷ which policy-makers take into account, and the strongest impact is likely to occur when there is a measure of agreement between poverty analysts.

According to Prof Carter, the researchers working on KIDS second wave might have managed to persuade government officials of their argument, but did not have much of an impact on policy itself:

I think the power of the '93 '98 work was, in a sense, holding up a mirror and saying, look, here's what's going, and doing that in a fairly sophisticated way and in a way that you couldn't have done without panel data. And so, in that sense, I think in many ways it might have been codifying what people kind of expected was the case, in terms of the way the South African economy was evolving, at the individual level, at the level of the household. In that sense it was not necessarily the kind of message that politicians, you know, would have been interested in. [] Some of the work Julian and I did was pointing at a lot of the constraints that people faced in income generation, access to finance and maybe land access, and things like that. We articulated those kinds of messages but I don't, as far as I know, none of them ever really got picked up. [] There were some of the things, particularly around rural financial markets, these were the kinds of ideas that did not exist in policy that we were talking about, but I don't know that it ever went anywhere. I don't think it did in terms of actually making anything happen. So, in that sense, we were looking at the good functionalities within the existing economy and trying to articulate these to people. I think we were fairly successful in getting people to see the power of what we were saying, that things were dysfunctional. I don't think we have been successful to date with our work in actually saying, and therefore the government should do and did do policy x, y or z. That's my own particular take on it. (Michael Carter, interview, 9 June 2004)

²⁷ Refers to the debate between the World Bank and UNDP advisors described in Section 3.

The researchers suggested that there is a much greater potential for more direct uptake by policy-makers in the third wave of KIDS, given its close involvement with the Department of Social Development, and the specific focus on the Child Support Grant.

By their nature, large household data sets do not often feed directly into policy immediately after being collected – I think this was the case with KIDS 1998. However, over the course of time as more work has been done with the data and a better understanding of it has emerged, there is more that is being learned from it. [] My sense is that KIDS-2004 will do an even better job of this, in part because it has been designed somewhat more to address critical policy questions (e.g., child care grants and HIV/AIDS responses); the 1998 survey was more general purpose. (John Maluccio, e-mail)

In addition to the lengthy time it can take for research to have an impact on policy, researchers and policy-makers also have to find ways of ‘bridging the gap’ between their two worlds in order to make the best use of available research for policy and strategy development. These issues and the lessons learnt by the researchers are discussed in greater detail below.

‘Bridging the gap’ between research and policy-making

Over the years of involvement in a range of poverty-related studies and extensive interaction with policy-makers, the researchers have gathered considerable experience in how to position oneself as a researcher, in order for one’s research to have any chance of impacting on policy. For instance, Prof May suggested that researchers have to make a decision about whether they are going to let their research “sit on a shelf”, or whether they are going to make the effort to get it heard by, and into the hands of, people who are in a position to use it. In some cases, to achieve the latter, researchers have to be proactive and persistent in order to gain entrance to the policy-makers’ world. This idea was encapsulated in an article written by Prof May and a colleague, which was somewhat tongue-in-cheek entitled ***Kicking down doors and lighting fires***.²⁸ In this regard, Prof May referred to an article in which it was argued that, as an anthropologist or social researcher, one is compelled to make certain choices about the role one will play in terms of the application, or otherwise, of one’s work:

You’ve got three choices and you can’t get out of them – either you are a collaborator and you’re collaborating with the elite for people to stay where they are, or you’re an activist, kicking down doors and lighting fires, or you’re a broker, because you know stuff you can get things for poor people. [] As academics we can broker very effectively, and I’m not convinced we can be such great activists. I’m certainly not convinced that I can make a great activist, I don’t think I’ve ever been a person who would want to go into the bush and fire an AK.²⁹ (Julian May, interview, 9 October 2003)

²⁸ May J & Attwood H (1998) ‘Kicking down doors and lighting fires: The South African PPA.’ In: J Holland & J Blackburn (eds), ***Whose Voice? Participatory Research and Policy Change***. London: IT publications, pp119-130.

²⁹ The AK-47 was the rifle most commonly used in the armed struggle against apartheid.

A second lesson that Prof May has learnt is that if you want to be heard and taken seriously by the current dispensation (i.e. the Mbeki government), you should not write letters or articles in the **Mail & Guardian** newspaper, especially if what you have to say might be construed as a criticism of government policy or practice. Prof May described his perspective as follows:

I've chosen not to go the Mail & Guardian route because I find that actually causes you, the doors get metal-plated or something like that. It is very hard for Patrick to get his ideas known now. It's kind of an automatic, you say Patrick Bond, no-one wants to talk to you. [] We have a government that, I don't know, is deeply neurotic about being embarrassed. I have no idea why, you know, they've got the best excuse of any government in the world for the problems that they've got to face, but they are not great at taking criticism and particularly not in public. I think it is much easier in a workshop to say, this is wrong, this is why your ideas are way off mark. But as soon as you go to the press, it seems, and they feel they have been publicly embarrassed, they'll never talk to you anymore. (Julian May, interview, 9 October 2003)

A third lesson learnt is that by putting the data in the public domain for other researchers, locally and internationally, to conduct their own analyses, can have a greater impact in the policy domain. Prof May explained this as follows:

*The closure of the RDP Office certainly made me aware that you can't just pick one target and I think that's what was done with the SA-PPA, we said the RDP Office is what it's all about. If we're going to get the Minister's advisor, someone really senior right involved in our project, we can get that communication going very quickly. And that proved to be a disaster as a strategy. The [**Poverty and Inequality Report**] said that if you embed yourself so closely in a political office, you may find yourself stifled, unable to talk and it's actually very hard to talk to other Ministries when you work for the President, it's seen as, it's got a particular political role to play in the country. [] and I had almost made a decision, I'm not going to have anything to do with them for a while. [] I joke about myself sulking with the government. [] If we start saying that we're part of civil society, by making this resource available to large numbers of researchers, getting many bits of government, or many NGOs, maybe that's the way of influencing change, you know, because then they're going to have multiple people blasting away with ideas using these data, instead of one person trying to deal with one person or dealing directly with or working very closely with government. Maybe that's not the approach, maybe the approach is to try and create an infrastructure whereby many are doing this. Maybe that seems to be more successful, I suppose. (Julian May, interview, 9 October 2003)*

Prof May also highlighted the ways in which the agendas, timeframes and project requirements of government can conflict with the integrity and process of academic research. In addition, he observed that because many policy-makers or government officials do not understand how research happens, they can sometimes make unreasonable or inappropriate demands:

The environment of the people in government that I've worked with has been one where they expect, they are required to have some notion of a deliverable and that deliverable determines access to funds, it determines the time that you get with them, the resources, the access to documents that they will provide you. Now that deliverable for them invariably is one per quarter and it starts when the financial year starts and it ends when the financial year ends. And adapting a research project around meeting that kind of requirement can affect how a project functions, it can affect who is on the project and that can mean that neither party is satisfied. [] And, as you know, the research project is not this linear thing where you can say we would have achieved this step, that step, that step and that step by March 2004, please give me the next tranche of money. And it does mean that sometimes things get forced into these time horizons, activities get forced into these time horizons to be able to meet the bureaucratic requirement of a project cycle. And I think there isn't also much notion of what analysis actually entails. I was in a discussion yesterday with the Social Development people and I put a budget to them and said, this is the work that we will put out to tender for a large survey organisation to do and then there's the qualitative, the ethnographic component of the study. And their response was, well why can't you put that out to tender? And it was very difficult for me as a researcher to explain that you can't hire out ethnographic – can you imagine hiring out your research, what you're doing here? You can't write terms of reference and put it out to a tender document and take whichever service provider, in their language, is the cheapest, and expect to get a decent job of qualitative research. [] And that, to me, is almost a disjuncture of language that starts to happen, from the perspective of a policy-maker. I don't think there is a very clear understanding of what research and what the process of doing research is. I had to think very carefully, how do I answer the question of why the ethnographic research can't be given to a private sector contractor, because it is such an alien question, I never dreamed that such a question exists! (Julian May, interview, 10 October 2003)

For Prof May, getting the balance right, in part, entails policy-makers upgrading their knowledge and skills, and researchers finding ways of making their research more accessible; in other words, both parties need to meet each other half way. In addition, Prof May highlighted the importance of training young researchers in the theory, methodology and practice of poverty research, some of whom, via future employment in the policy domain, will help to improve government's ability to understand, absorb and apply KIDS-like research:

You know, it's also a question I wouldn't mind you asking policy-makers, because I think there's also that step, perhaps they would need to say, how can I get more in the head of the researcher? I must say one of the things I do see is how universities can help to provide people to go into policy-making, who are better equipped to understand and absorb research, to be more critical of research. I think of, in our Masters class, I always imagine 80% will go into the government or NGOs or into the private sector, and

certainly a lot of our approach is teaching people how to read research reports critically, how to understand them, how not to be taken in by bad research. [] Maybe you've sort of just caught me in a bad space. I'm spending a lot of time now talking to people in policy, trying to communicate about our research project, and I'm sort of feeling frustrated thinking, hang on, why don't you guys go and get some qualifications or go and do a course and figure out how to do it, instead of me having to explain to you how to do your job all the time. There's a frustration that I have and I am not 100% sure what more I can do except perhaps quite seriously trying to learn to be calm more and to be willing to explain, take the time to explain. (Julian May, interview, 10 October 2003)

An ongoing challenge for researchers in general, and for those involved in the KIDS project, is to develop the skill to write accessible, user-friendly documents which meet policy-makers' needs; as opposed to the denser, more theoretical or technical documents that are targeted at an academic audience. But, again, for Prof Julian May it's a question of balance – between academics writing user-friendly reports and policy-makers improving their capacity to engage with theory:

There's the obvious criticism that getting out of the style of writing academic papers, of being too academic and I know I've been accused of that frequently in interactions with government. The document is seen as too academic. And I have got frustrated saying, its academic because the topic is, it requires theory, you can't understand poverty without theory, there is theory. And I do know that there is a language thing and it's hard not to, I know, my colleagues tell me this, not to see the user-friendly version as the 'dumb-down' version. [] At some point you start thinking, I'm 'dumbing this down'. But there's also the requirement on the side of the reader to get up to speed. For heaven's sake, you can't be a policy-maker concerned about poverty if you actually don't know the theory about this. There's got to be a two-way thing of awareness. Let's not use jargon, let's stay away from unnecessary technicality. [] It's unnecessary to put so much math into documents and make it understandable. The math is there to impress other economists. The policy-maker doesn't need to be impressed; presumably they wouldn't be talking to you if they didn't think that you knew what you were talking about. (Julian May, interview, 10 October 2003)

In Mr Ben Roberts' opinion, the South African government is becoming far more aware of the need to use research to inform the design and evaluation of poverty reduction interventions, and that the 'gap' between the worlds of research and policy development are starting to close:

Certainly in the past there has been some sort of divide there. [] But if you see what government is doing today, the extent to which monitoring and evaluation is going on is actually quite impressive, relative to say five, seven years ago. And I think initiatives like KIDS are helping to promote this notion of using data to help inform the actual design of policies. That gap, the 'two communities' issue, sure I think it does exist to an extent, but I think inroads have been made and we are starting to make progress – on both counts: I

think that the research community is learning to package their information in a way which is much more user-friendly to officials; and, on the other side, I think also there is a greater awareness of how survey data can inform decision-making. (Ben Roberts, interview)

Finally, Dr Maluccio suggested that there is a much greater potential for uptake if policy-makers and other potential users are involved in the initial conceptualisation and design of a project:

The interaction is much improved when questions designed by the policymakers are included/addressed up front in the design of the project. An example is my work in Nicaragua where we are evaluation a government program – the research findings have direct and immediate effect. (John Maluccio, e-mail)

5.3 Knowledge transfer

The third form of utilisation is knowledge transfer to postgraduate students, young researchers and potential users, especially in the policy domain. As the project narratives highlighted, Prof May and Prof Carter have always placed an emphasis on involving postgraduate students and young researchers in the projects, in order to build their capacity in the theories and methodologies in the field. This ‘young researcher methodology’ involves the practice of ‘peer-on-peer learning’, in which younger researchers are coupled with senior researchers, who act as mentors. A number of these young researchers or postgraduate students have since taken up employment in government and industry, which is regarded as a very important form of knowledge transfer. Dr John Maluccio, a researcher at IFPRI and a young researcher during the KIDS second wave, described the various ways in which his involvement in the KIDS project influences his current work:

Currently, the work I did [in the KIDS project] influences how I approach other projects, both from the nuts and bolts of running a survey, to the types of analyses I carry out (e.g., paying attention to social capital or social relations), to the type of outreach I do (trying to involve government stakeholders early on). [] I have used KIDS data for analysis and scholarly articles and as a training tool in a graduate course I was teaching. (John Maluccio, e-mail)

Knowledge is also transferred to the broader postgraduate population via coursework in the Masters programmes.

As was highlighted earlier, information dissemination took place via presentations and workshops with external stakeholders. In addition, in two instances researchers have been ‘seconded’ to government – another important form of knowledge transfer. The first of these was Mr Ben Roberts, who was seconded to the National Treasury for two months in 2000. Mr Roberts described his role during this secondment as follows:

I was seconded to the National Treasury for October and November 2000, to help with the allocation process for the Poverty Relief Fund. More specifically, I helped with the assessment of business plans submitted by various departments to National Treasury in order to receive funding from

the PRF. Once we had made the allocation decisions, I also assisted with the preparation of the cabinet memorandum outlining the disbursement plans for the PRF in the forthcoming fiscal year. During my secondment, presentations on the KIDS findings were made to Treasury and other government officials. The secondment therefore did help to sow the seeds of a long-standing relationship between Julian and the members in Treasury responsible for the Poverty Relief Fund. (Ben Roberts, e-mail)

More recently, one of the young researchers working on the KIDS third wave project is also working very closely with officials in the national Department of Social Development. Prof Julian May described this as follows:

Nina Hunter, who is kind of the next person to come after Ben, has been – not quite a secondment – but working very closely with the Department of Social Development. And not as a consultant, in other words, as consistent support. (Julian May, interview, 9 October 2003)

In summary, it appears that important contacts with the relevant government officials and policy-makers have been established, and that the wheels are in motion for knowledge transfer and uptake to take place. As suggested earlier in this report, these efforts are likely to be deepened and expanded as a result of the KIDS third wave.

6 Concluding observations and lessons learnt

The KwaZulu-Natal Income Dynamics Study (both the second and third waves) has been a highly collaborative endeavour, drawing together the skills and expertise of economists and social scientists from different research areas, institutions and countries. A number of young researchers and postgraduate students have also participated in the projects, through which they have acquired skills, expertise and experience in undertaking poverty research. In particular, over the years, the project leaders have developed and refined their ‘young researcher methodology’ which, through the practice of ‘peer-on-peer’ learning, enables novice researchers to learn from their more senior counterparts.

The KIDS projects have expanded and deepened our theoretical understanding of the nature, causes and dynamics of poverty. They have also generated datasets which are unique and critical resources for analysing poverty, and which add to the ongoing accumulation of data and findings on poverty research in South Africa. A significant form of utilisation included the use of the KIDS data, findings and theoretical underpinnings by other academics, both locally and internationally, for further research. In this regard, web sites such as the South African Data Archive, the World Bank’s Africa Databank, and IFPRI, all of which house the KIDS dataset, serve as important vehicles for knowledge transfer.

The description of both the background to and undertaking of the KIDS projects in Section 3 highlighted the political nature of poverty research in particular, and of social research in general. The politics of research were evident in the researchers’ interactions with international funding agencies, and in particular the World Bank, which to a large extent reflects the ongoing North-South divide. For example, we saw how the World Bank did not make any funding available for the analysis of South African poverty data

(1993 SALDRU study) by South African poverty researchers. When the Bank did agree to provide funding for the analysis, they did so on the proviso that one of their own advisors was a member of the team. By Prof May's and Prof Carter's accounts, the World Bank was primarily concerned about how to control the approach to the analysis by the South Africans, perceiving them to be 'Stalinists' and 'Trotskyites' who were unlikely to tow the line of the 'free marketeers' and their neoclassical liberal economics. The politics surrounding the definition and measurement of poverty – and thus its solution – were also evident in the raging debate between the World Bank and UNDP advisors during the August 1996 workshop. Over the years, Prof Julian May and colleagues have continued to challenge mainstream (read: *from the North*) ideas about poverty and its relation to the macro economy, by introducing new ideas about the role of assets and social capital in the perpetuation of poverty, and the dynamics of poverty, as well as ideas for policy development and government intervention for poverty alleviation in the South African context.

The political nature of poverty research was also evident in the researchers' interactions with the South African government over the years. For example, we saw how, during the **Poverty and Inequality Report** process, the Reconstruction and Development Programme office was closed, and the project was transferred to the Deputy President's office. According to Prof May, this caused great instability in the process: not only did he and his colleagues lose the contacts they had built up in the RDP office, but the very focus and approach to the *Poverty and Inequality Report* shifted under the new supervision. Prof May also highlighted the delicacy with which one needs to interact with government, given their sensitivities towards critical comment. In particular, he argued that if one wants to obtain and retain the 'ear of government' one should refrain from making public criticisms about government policy or practice, especially in apparently leftwing media such as the *Mail & Guardian* newspaper. In this regard, Prof May suggested that researchers have to decide on what role they are willing to play – collaborator, broker or activist – in bringing about policy impact through their research.

The narrative in Section 3 also highlighted the accumulative but non-linear and indeterminate nature of research lines or paths. Firstly, it became clear how both the theoretical and methodological lessons learnt by researchers such as Julian May and Michael Carter slowly accumulated over time, from the first round of analysis of the SALDRU data to the development of a proposal and business plan for the KIDS third wave. Secondly, at the time of doing the analysis of the SALDRU data, neither Prof May nor Prof Carter were clear about how their current work would unfold in the future, into what we now know as the trajectory of the KIDS second and third waves. Instead, new questions and issues emerged over time which shaped their individual and collaborative research paths.

The KIDS projects were not without their difficulties. For example, the researchers faced a number of challenges in obtaining funding for the projects, not least because of the very high costs involved in undertaking a panel study of this kind. In addition, they were faced with problems in the field; in particular, the problem of the fabrication of data in certain geographical clusters which they discovered during the 1998 fieldwork.

Some of the greatest challenges that the researchers faced, however, have to do with finding ways to gain entrance to the policy domain. The case study has highlighted a range of important lessons learnt by the KIDS project team about how to ‘cross the threshold’ from research on poverty to policy development for poverty alleviation, given that data and theory are not always easily translated into actions by government. These lessons are briefly summarised below:

- ◀ The importance of ongoing networking with policy-makers to facilitate government buy-in and research uptake. It appears that any hope of research impacting on policy-making comes from years of work and persistence in networking and interacting with targeted stakeholders, on the part of the researcher(s).
- ◀ The importance of not ‘putting all your eggs in one basket’, so to speak, in terms of who in government is targeted. This observation is based on Prof Julian May’s experiences during the *Poverty and Inequality Report* process, during which the Reconstruction and Development Programme office was closed, and the project was transferred to the Deputy President’s office. One of the strategies employed by Prof May and his colleagues is to make the data publicly available, in the hope that a broader group of researchers will work on the data and disseminate findings to policy-makers, in order to achieve wider impact and therefore potential uptake. And while the KIDS project team has targeted specific government departments, such as the National Treasury and the national Department of Social Development, since these bodies are most closely involved in poverty alleviation policy and strategies, the individual researchers also participate in a number of other bodies (such as the Statistics Council) through which they can interact and disseminate the findings and methodology more broadly.
- ◀ Finally, the importance of the research and policy communities ‘meeting each other half way’ was emphasised. In other words, the researchers, on the one hand, need to ensure that their research outputs are communicated (or written) in an accessible and useful way for policy-makers; on the other hand, policy-makers need to ensure that they are adequately skilled in order to engage with econometric or sociological research on poverty.

Despite the difficulties associated with getting research findings into the policy domain, the research team was aware of instances where the results of the KIDS second wave had been drawn on in presentations by government ministers or in government documents. To the extent that the KIDS researchers have been successful in making some sort of impact on policy, in part this is attributable to the fact that they take a keen interest in keeping an eye on and talking about how their research can inform policy. In Section 5, I highlighted the fact that the researchers undertake their own scans of the research literature to keep track of who is using the KIDS data, and how; that they document their reflections on the lessons learnt about getting research into the policy domain; and, that they communicate these ideas to the policy-makers themselves. The researchers remain confident that the extended dataset that will be generated via the KIDS third wave, and the closer involvement of certain government departments in both the conceptualisation and implementation of the project, will only serve to enhance the opportunities for utilisation and policy impact in the future.

In conclusion, the KIDS projects contribute to national goals, both in terms of their focus and their form. Firstly, the substantive focus of the projects is on poverty – one of the key challenges facing South Africa today – with the specific intention of improving our understanding of the nature of the phenomenon, and for using this understanding to inform policy development and interventions. Secondly, the projects play an important role in building the capacity of a new generation of researchers in the field of poverty research, and developing international networks of expertise.

Data sources

Face-to-face interviews

Prof Julian May (Project leader, University of KwaZulu-Natal), 9 and 10 October 2003

Prof Vishnu Padayachee (Head: School of Development Studies), 9 October 2003

Telephonic interviews

Prof Michael Carter (Project leader, University of Wisconsin-Madison), 9 and

11 June 2004

Prof Francie Lund (Project leader, SEPPI project, School of Development Studies),

14 June 2004

Mr Ben Roberts (Member of project team), 4 August 2004

E-mail responses to questions

Dr Lawrence Haddad (Project leader, IFPRI), June and August 2004

Dr John Maluccio (Member of project team, IFPRI), 5 August 2004

Mr Ben Roberts, 9 August 2004

Questionnaire

'Public sector R&D in South Africa: The production and utilisation of research'
questionnaire completed by Prof Julian May, September 2003

Publications and project documents

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Appendix 1: Professional backgrounds and research interests of the principal investigators

Associate Professor Julian May is director of the School of Development Studies' Population and Poverty Studies Programme. His research interest is in the dynamic analysis of poverty, and in the relationship between persistent poverty, asset accumulation and sustainable livelihoods. He has published almost 50 articles in both South African and international books and journals in this field, as well as numerous research papers and consultant's reports. In 2000, Julian edited "Poverty and Inequality in South Africa: Meeting the Challenge". This book published by David Phillip and Zed Press documents the first 4 years of poverty reduction policies undertaken by the first democratic government of South Africa. Julian has also worked with a number of governmental departments in the development of policy options and systems for monitoring the impact of policy, including the social security grants. Internationally, he has worked on an evaluation of the World Bank's social fund programme in Jamaica, Nicaragua, Zambia and Malawi, bio-diversity studies in Mozambique and Namibia, and on micro-enterprise support in Lesotho. He was also the principle researcher for the Poverty Indicators Study of Mauritius. In 1999, he was appointed by the UNDP onto an evaluation team to examine the impact of their \$20 million Poverty Strategy Initiative. Recently, he has worked in Lesotho and the Maldives developing national poverty monitoring systems. He is a member of the South African Statistics Council, an Associate Researcher at the International Food Policy Research Institute and at the Department of Social Policy, Oxford University.³⁰

Professor Michael Carter is a researcher and academic in the Department of Agricultural & Applied Economics at the University of Wisconsin-Madison. Prof Carter's research focuses on the nature of growth and transformation in low income economies, giving particular attention to how inequality in the distribution of land and other assets shape, and are shaped by, economic growth. While working primarily through the econometric analyses of household and firm level data, he has also made theoretical contributions in the areas of asset accumulation, institutional innovation and credit rationing. Since 1980, Michael has been involved in a number of research projects in Latin American, Africa and Asia. He has been working on South African income distribution dynamics since 1994 when he joined the team analysing the SALDRU survey data. Prof Carter's current projects include analyses of the safety net features of property rights systems in China, the impact of liberalization on the welfare of the rural poor in Central America, and social capital and the reproduction of inequality in ethnically stratified societies.³¹

³⁰ Source: <http://www.ukzn.ac.za/csds/Index.htm>.

³¹ Source: <http://www.aae.wisc.edu/www/fac/cv/carter.asp>.

Department of Agricultural & Applied Economics, University of Wisconsin-Madison

The Department of Agricultural & Applied Economics at Wisconsin was the first established in the United States. Farm management, marketing, and land economics were early areas of concentration. An international dimension evolved in the 1920s, when faculty organized regular seminars on international land tenure problems.

Today, department staff continue their engagement in research and teaching in the broad area of agricultural economics, as well as making inputs into the policy process. Through the University of Wisconsin Extension service, the faculty work on applied problems as various as school finance reform, the impact of trade agreements on local economies, and milk pricing and dairy policy. Grants from the National Science Foundation, USDA, the MacArthur and Ford Foundations, the World Bank, the United States Forest Service, the Sea Grant Institute and USAID have supported faculty research in recent years, often with graduate student collaboration.

Major research areas in the Department include:

- Environmental and Resource Economics
- Growth and Development in Low-Income Economies
- Agricultural Production and Technical Change
- State and Local Economics
- Global Markets and Trade
- Resources and the Environment in Economic Development
- Markets and Prices in the Food System

The Department offers programs of study at the undergraduate and graduate level.

Source: <http://www.aae.wisc.edu/www/>

Dr Lawrence Haddad joined IFPRI as a research fellow in 1990. From 1994 until very recently, he was the Director of the Food Consumption & Nutrition Division. In July 2004, Dr Haddad was appointed as the Director of the Institute for Development Studies at the University of Sussex. Dr Haddad's overall research focus is on the design and impact of policies and programs to reduce poverty and malnutrition. In particular, the KIDS project relates to a multi-country programme within the Institute entitled "Pathways from poverty" which looks at long-term panels in Ethiopia, Guatemala, Bangladesh and Malawi (Lawrence Haddad, email; <http://www.ifpri.org/srstaff/HaddadL.htm>).

Targeted interventions to reduce and prevent poverty (Food Consumption and Nutrition Division, IFPRI)

The general orientation to this research programme is described on the IFPRI web site as follows:

“Research undertaken under the umbrella of the multi-country program seeks to understand the causes of poverty, food insecurity and poor nutrition, and the impact of interventions designed to remedy these. Results generated are applied to the design of improved policies and interventions, better instruments and criteria for efficient and cost-effective support programs in countries with differing socio-economic circumstances, technical capacities and budgetary and administrative constraints. Both research and outreach activities are critical to the success of the research program.”

The main research activity since 1996 has been the collection, collation and cleaning of primary level (principally household) data. The research programme is funded by the Department for International Development, the International Fund for Agricultural Development, the United States Agency for International Development, and the World Bank.

Source: <http://www.ifpri.org/themes/mp18.htm>

Dr John Maluccio is a Research Fellow in the Food Consumption and Nutrition Division at IFPRI. Dr Maluccio was very involved in organising the questionnaire (i.e. combining the contributions from the three project leaders), interviewer training, data entry oversight, data cleaning, public data release, and data analysis for the KIDS second wave. John joined IFPRI as a post-doctoral fellow in 1997 to work on the research programme analysing the intra-household allocation of resources in South Africa and Ethiopia. John's current research interests include investments in human (health, nutrition and education) and social capital at the individual and household levels. John directs a research programme on the evaluation of targeted nutrition interventions in which rigorous evaluations (e.g. using randomised design) of programmes are carried out in order to assess their targeting, effectiveness and cost-effectiveness.³²

Mr Ben Roberts is currently a Chief Researcher in the Integrated Rural & Regional Development programme of the Human Science Research Council, and is based in Durban. At the start of the KIDS second wave (in early 1998), Ben had just completed the coursework component of his Masters degree. He was drawn to the KIDS project because the overall objectives of the project reflected his own interests:

I had a basic interest in poverty and world development. I was particularly excited at the prospect of a project that was particularly trying to engage with the dynamic notions of poverty rather than the standard, trying to debunk some of the standard theories around poverty as a much more static phenomenon. (Ben Roberts, interview)

Mr Roberts therefore approached Prof May with regard to him working on the KIDS project, and using the data for his Masters research. Ben was seconded to Data Research Africa for the duration of the fieldwork (February – June 1998). He was involved in the fieldwork for the project, supervised one of the fieldwork teams, and was closely involved in quality control. (Ben Roberts, interview)

³² Sources: John Maluccio, email; <http://www.ifpri.org/srstaff/Malucci.htm>.

Associate Professor Francie Lund is a researcher in the School of Development Studies at the University of KwaZulu-Natal. Prof Lund's research Interests include: social policy: analysis of the effects of new social programmes on patterns of poverty; social security: analysis of the relationship between state social assistance especially the Old Age Pension, Disability Grant, and grants for women and children, and household formation, and patterns of poverty; and, women street traders: A research programme for the Self Employed Womens Union in South Africa, with links to women street traders organisations in Ghana, Kenya, and Cote d'Ivoire.³³

Dr Michelle Adato, a sociologist, is a Research Fellow in the Food & Nutrition Division of IFPRI. Dr Adato's work focuses on human capital based poverty reduction programs, employment and work, poverty dynamics, and processes related to the participation of local government and community-based organizations in development programs. She also co-leads a four-country study of the impact of agricultural research on poverty.³⁴

³³ Source: <http://www.ukzn.ac.za/csds/Index.htm>.

³⁴ Source: <http://www.ifpri.org/>.

Appendix 2: Selected list of KIDS publications

Journal articles and working papers

- Adato M, Lund F & Mhlongo P (2003) 'Innovations in mixed methods to understand poverty dynamics: A multidisciplinary approach to longitudinal research in KwaZulu-Natal, South Africa.' In: C Moser (Ed), *Urban longitudinal research methodology: Objectives, contents and summary of issues raised at the Joint DPU-ODI-World Bank-DFID Workshop*. DPU Working Paper, No. 124. London: University College London
- Carter M & May J (2001) 'One kind of freedom: Poverty dynamics in post-apartheid South Africa.' *World Development*, 29(12):1987-2006
- Haddad L & Maluccio JA (2003) 'Trust, membership in groups, and household welfare: Evidence from KwaZulu-Natal, South Africa.' *Economic Development & Cultural Change*, 51 (3).
- Maluccio J (2000) 'Attrition in the KwaZulu-Natal Income Dynamics Study 1993-1998.' *FCND Discussion Paper No. 95*, October 2000
 - Maluccio JA, Haddad L & May J (2000) 'Social capital and income generation in South Africa 1993-1998.' *Journal of Development Studies*, 36(6):54-81 (also published as *FCND Discussion Paper No. 71*, September 1999)
- May J & Roberts B (2001) 'Panel data and policy analysis in South Africa: Taking a long view.' *Social Dynamics*, 27(1)
- May J, Carter MR, Haddad L & Maluccio JA (2000) 'KwaZulu-Natal Income Dynamics Study (KIDS) 1993-98: A longitudinal household database for South African policy analysis.' *Development Southern Africa*, 17(4):567-81 (also published as *CSDS Working Paper No 21*)
- May J, Maluccio J & Haddad L (2000) 'Social capital and development in South Africa: 1993-1998.' *Journal of Development Studies*, 36(6):54-81 (also published in Baulch B & Hoddinott J (eds), 2000, *Economic mobility and poverty dynamics in developing countries*, p54-81, Frank Cass, London)

Conference papers

- Adato M, Carter M & May J (2003) *Poverty and structural change in KwaZulu-Natal: Integrating quantitative and qualitative data to analyse livelihoods and poverty dynamics*. BASIS CRSP Policy Conference on Combating Persistent Poverty in Africa, pre-workshop. Cornell University, November 14-15, 2003
- Adato M, Carter M & May J (2003) *Poverty and structural change in KwaZulu-Natal: Integrating quantitative and qualitative data to analyze livelihoods and poverty dynamics*. Paper presented at the Policy Conference on Socially Embedded Inequality and Economic Mobility: Livelihoods, Social Networks and Exclusion in Peru and South Africa. December 4, 2003. International Food Policy Research Institute (IFPRI)
- Adato M, Lund F & Mhlongo P (2003) *Capturing 'work' in South Africa: Evidence from a study of poverty and well-being in KwaZulu-Natal*. Paper presented at the Policy Conference on Socially Embedded Inequality and Economic Mobility: Livelihoods, Social Networks and Exclusion in Peru and South Africa. December 4, 2003. International Food Policy Research Institute (IFPRI)

- Adato M, Lund F & Mhlongo P (2003) *Understanding poverty dynamics: Innovations in mixed method research to conduct longitudinal research in KwaZulu-Natal, South Africa*. Paper presented at the World Bank workshop on “Moving out of poverty: Understanding growth and freedom from the bottom up”, July 15-17 2003, Washington DC
- Adato M, Lund F & Mhlongo P (2004) *Methodological innovations in research on the dynamics of poverty: A longitudinal study in KwaZulu-Natal, South Africa*. Paper presented at Q-Squared in Practice: A Conference on the Experiences of Combining Qualitative and Quantitative Methods in Poverty Appraisal. Centre for International Studies, University of Toronto, May 15-16 2004
- Carter M & Castillo M (2003) *An experimental approach to social capital in South Africa*. Paper presented at the Policy Conference on Socially Embedded Inequality and Economic Mobility: Livelihoods, Social Networks and Exclusion in Peru and South Africa. December 4, 2003. International Food Policy Research Institute (IFPRI)
- Haddad L, Maluccio J & May J (2003) *Participation, trust, and the performance of groups in KwaZulu-Natal*. Paper presented at the Policy Conference on Socially Embedded Inequality and Economic Mobility: Livelihoods, Social Networks and Exclusion in Peru and South Africa. December 4, 2003. International Food Policy Research Institute (IFPRI)
- May J & Roberts B (2000) *A dynamic analysis of household livelihoods and asset accumulation in post-apartheid South Africa: Evidence from KwaZulu-Natal*. Paper presented to the CSAE Conference “Opportunities in Africa: Micro-evidence on firms and households”, Centre for the Study of African Economies, St Catherine's College, Oxford, April 9th-10th, 2000
- May J (2002) *The persistence of poverty in South Africa*. Paper presented to a Centre for International Poverty Research/Centre for Development Studies seminar, University of Bergen, 16 October, 2002, Bergen, Norway
- May J (2003) “Talking to the Finance Minister about poverty”: *Pro-poor policy and the political economy of information*. Paper prepared for the Conference on Chronic Poverty, Chronic Poverty Research Centre, University of Manchester, 8-10 April, United Kingdom
- May J, Maluccio J & Haddad L (1999) *Social capital and development in South Africa: 1993-1998*. Paper presented at the IDS-IFPRI Workshop, “Economic Mobility and Poverty Dynamics in Developing Countries”, Institute for Development Studies, University of Sussex, 7th – 8th April, 1999

CASE STUDY 13

THE CENTRE FOR THE STUDY OF HIGHER EDUCATION AT THE UNIVERSITY OF THE WESTERN CAPE

Straddling the divide between research and policymaking

The Centre for the Study of Higher Education at the University of the Western Cape is guided by the current Director, Prof George Subotzky

by Tembile Kulati



Graphic courtesy of the CSHE website [<http://www.epu.uwc.ac.za/>]

CONTENTS

Abbreviations	557
1 Introduction	558
1.1 Aim of the study	558
1.2 Background and rationale	558
2 Overview of the higher education policy development context	559
2.1 The first phase of policy development: Pre-1990	559
2.2 The second phase of policy development: 1990-1994	560
2.3 The third phase of policy development: 1995-1999	562
2.4 The fourth phase of policy development: Post-1999	564
3 A description of the Centre for the Study of Higher Education (CSHE)	566
3.1 Organisational history of the CSHE	566
3.2 Objectives of the research programme	567
3.3 The research programme of the CSHE	568
3.4 Changes in research orientation	572
3.5 The current research and teaching programme of the CSHE	575
3.6 Funding	577
4 On the utilisation of research in policymaking	578
4.1 Who are the intended users?	578
4.2 Mode of knowledge use	582
5 Conclusion	584
Data sources	587
Face-to face interviews	587
Publications and documents	587

Abbreviations

ANC	African National Congress
CEPD	Centre for Education Policy Development
CHE	Council on Higher education
CSHE	Centre for the Study of Higher Education
DoE	Department of Education
EPU	Education Policy Unit
IPET	Implementation Plan for Education and Training
MDM	Mass Democratic Movement
NCHE	National Commission on Higher Education
NECC	National Education Co-ordinating Committee
NEPI	National Education Policy Investigation
NETF	National Education and Training Forum
NQF	National Qualifications Framework
SAQA	South African Qualifications Authority
USAID	United States Agency for International Development
UWC	University of the Western Cape

1 Introduction

1.1 Aim of the study

The aim of this report is to examine the relationship between research and policymaking in South African higher education, using the Education Policy Unit (recently renamed as the Centre for the Study of Higher Education) at the University of the Western Cape as a case study¹. The process of policy development in South Africa, which is the subject of the section that follows, provides the backdrop of the examination of the central questions of this study. In order to explore and examine some of the dynamics underlying the utilisation of research in higher education policymaking in South Africa, the study is guided by the following questions:

- ⤷ What have been the objectives of the research programmes of the CSHE since its inception in 1992 to the present? To what extent have these changed over the years?
- ⤷ To what extent has the CSHE succeeded in producing research that has been able to influence policymaking or shape the higher education policy discourse?
- ⤷ Who have been the main beneficiaries of the research output of the CSHE's research programme? (How) has this changed over the years?
- ⤷ What has facilitated or hindered the ability of the CSHE to get its research products or output utilised in policy development?

A limitation of the study was the lack of detailed information on the research projects undertaken by the CSHE for the Department of Education. Prof George Subotzky, the Director of the CSHE was reluctant to discuss the specifics of the research commissions that were undertaken for the Department of Education for fear of (potentially) jeopardising what seemed to be an already strained relationship. The author also had difficulty in obtaining records of meetings, correspondence, and progress reports that were related to these projects, except for the final research reports that were submitted to the Department. For this reason, this case study will not focus on any particular project of the CSHE, but will examine the issues relating to the utilisation of research in policymaking in relation to the work of the CSHE as a whole.

1.2 Background and rationale

Prior to the mid-1970's, when researchers in the United States began to conduct studies to interrogate the extent of the influence and/or impact of social research on policymaking, it had been taken for granted that what policymakers required to help them in their decision making - and which social research was best qualified to provide - was advice derived from reliable data, rigorous analysis, and well thought-out findings or research conclusions. In this regard, social research was seen as the *sine qua non* for the development of social interventions and policies that would be able to address the problems facing societies.

¹ Although the Education Policy Unit at the University of the Western Cape changed its name to the Centre for the Study of Higher Education in 2002, the latter will be used throughout this case study.

The first Education Policy Units (at the University of the Witwatersrand and the University of Natal) were established in the late 1980s by the National Education Crisis Committee (NECC) to conduct research and training programmes in various areas of education, and were an important component of the NECC's strategy of "reconstructing education in the midst of struggle" (Samoff, 1995: 21). Later developments such as the National Education Policy Investigation (NEPI) exercise and the establishment of the Centre for Education Policy Development (CEPD) in 1995 - which was set up as an education policy development arm of the African National Congress (ANC) - also ushered the EPU's towards research projects whose main objective was to contribute to policy development.

The CSHE was established in 1992 to conduct "high-level theoretical and empirical research on alternative education policies for a new democratic South Africa", with higher education as the specialised area of study (UWC-EPU, 1991: 5). Indeed, the document that outlines the research and training of the CSHE argues that it was a particular conception of the role of research in policy formation, namely that the formulation of education policies "depends, in the first instance, on the availability of a body of relevant knowledge which can only be generated through the research process" (EPU, 1991: 7), that prompted the initiative to establish the organisation at the University of the Western Cape. It is to the examination of the issues underlying this "particular conception of the role of research in policy formation" that is the subject of this study.

2 Overview of the higher education policy development context

The purpose of this section is to provide an overview of the process of policy development in South African higher education. Policy development in higher education can be traced to the launch of the National Education Policy Investigation (NEPI) by the National Education Co-ordinating Committee (NECC) in December 1990. This section will divide the process of policy development in South African higher education into four phases, which more-or-less coincide with some of the defining moments in South Africa's political history on the one hand, as well as the key milestones of the post-apartheid higher education system on the other. We will now turn to a discussion of each of these phases.

2.1 The first phase of policy development: Pre-1990

It is probably incorrect to characterise the pre-1990 period as the 'first phase' of policy development because, strictly speaking, no formal or conscious process of constructing policy propositions or positions was undertaken prior to 1990. However, it was an important period since the popular struggles that were waged against apartheid education during most of the 1980s provided the background material for much of the writing that emerged in this period. It is important to remember that the 1980s were characterised by mass mobilisations in opposition to apartheid education, which were waged under the banner of the NECC, and were met by a violent response from the state.

Consequently, much of the research undertaken by progressive research organisations in this period - especially the two Education Policy Units (EPUs) that were established in late 1987 by the NECC at the Universities of Natal and the Witwatersrand - was geared towards servicing the broader, mass-based education struggle. Very little, if any, of the

research that was produced in this phase was geared towards informing, or contributing to, policy development. If anything, much of the research that was produced by the EPU and the broader progressive research community during this period was academically oriented writing that developed a sophisticated theoretical critique of apartheid education and its policies. Müller (2000: 272) has stated that for much of this period, the EPU were “confused and torn by conflicting loyalties” between engaging in activism on the one hand, and undertaking scientific/intellectual work, and shuttled “unsatisfactorily” between the two.

If we were to reflect on the role of (policy) research during this period, it is clear that it played very much an ideological and mobilisation function. Although the research that was produced by the two EPU that were existing at the time – at the Universities of Natal and the Witwatersrand - was targeted at an academic audience, it was also directed at providing the NECC leadership with intellectual and strategic support although, as Müller (2002) has suggested, what such assistance entailed never was fully clarified by the NECC.

Nevertheless the (political) intent was clear: the EPU and other independent progressive academics and non-governmental organisations that were aligned to the Mass Democratic Movement (MDM) were expected to provide ‘intellectual ammunition’ to the NECC’s campaigns against apartheid education. In this respect, the role of research was seen to be firmly in the service of the broader political struggles being waged against the apartheid state. It is probably safe to deduce that the primary purpose of the research that was being produced (by the EPU) during this period was to undermine and de-legitimize the ideological and epistemological foundations of apartheid education.

2.2 The second phase of policy development: 1990–1994

A key component in the debates and deliberations on the nature of post-apartheid South Africa was on the role that the new democratic state would play in reconstruction and development, and especially in the transformation of sectors such as health, education, and the economy. This period is unique in that the policy development process was characterised by a high degree of participation by mass-based community organisations. Non-governmental organisations and other organs of civil society played a major role in the various policy forums and initiatives that were geared towards developing alternative policy options not only in education but in other (social) sectors as well.

The key initiative in this period was the National Education Policy Investigation (NEPI), whose central objective was to interrogate policy options in all areas of education, within a value framework that was derived from the ideals of the broad democratic movement (NEPI, 1992). Overall, the NEPI initiative was an attempt to address three objectives, namely to (NEPI, 1992: vii):

- ◀ Provide information about the state of education and a lens to focus on the values that ought to underpin the specification of policies for a future education dispensation
- ◀ Stimulate public debate on education policy in all spheres of society, and
- ◀ Begin a process of developing capacity for future policy analysis.

NEPI - an initiative of the NECC that was conducted between 1990 and 1992 - was a massive education research and policy (options) development exercise that involved over 300 academics, educators and activists, who were organised into twelve research groups covering areas from early childhood educare to higher education (NEPI, 1992). The main achievement of NEPI, insofar as the higher education sector was concerned, was to facilitate a certain measure of convergence among the main actors in higher education with regard to a common understanding with regard to the goals, values and principles that would underpin a transformed system of higher education.

Although the EPU's played an influential role in the conceptualisation and the setting up of the NEPI exercise, as well as in shaping and influencing some of the key strategic decisions that were taken - through the participation of the EPU Directors Forum in the NEPI editorial group - their contribution to the actual NEPI research effort, in the form of research papers and contributions, was negligible (Taylor, 1992). It seems that the shift from undertaking research that was steeped in critique to being involved in the development of policy options for a government-in-waiting was not a smooth transition for the EPU's.

Müller (2000: 273) points out that the EPU's greeted with "stunned apprehension" the rapid changes that followed after February 1990, since what was needed by the progressive movement - policy assistance in preparing to govern - went against the EPU's whole training and orientation, steeped as it was at that time in the critique mode. Reinforcing this viewpoint, Sehoole (2002: 92) has argued that the EPU's' tradition of critique gave rise to a level of "hostility" towards work that involved policy formulation, since this was regarded as the domain of government.

A perspective that was being articulated within EPU circles at the time saw their role as that of 'critical reconstructionists' (Chisholm, 1992; Taylor, 1992). By this was meant that the central role of the EPU's ought to be about placing the research questions being posed by organisations (primarily from the democratic movement) in a systemic perspective, and to explore their underlying value framework and assumptions, as well as their implications for different policy options. There was a strong view - which came to be reflected in the manner in which the recommendations of NEPI were finally written - that the EPU's were not policy actors pursuing the views of one or another constituency. Rather, the main objective of their research endeavour was to examine the policy proposals of the democratic movement, as well as those of the apartheid state, in a systematic and critical manner, and to explore the value and transformative implications of the options being proposed (Taylor, 1992).

The establishment of the Centre for Education Policy Development (CEPD) in late 1992 by the ANC - as its education policy "think tank" - saw the EPU's getting more involved in research projects that had a more direct link to the formulation of policy proposals for a new education dispensation. The CEPD played a central role in the early development of the ANC's education policy propositions, and was responsible for co-ordinating the research work that led to the production of the ANC's **Policy Framework for Education and Training** (the so-called 'Yellow Book'), which was published in January 1994. The CEPD was also responsible for the co-ordination of the Implementation Plan

for Education and Training (IPET), an exercise which followed the publication of the ‘Yellow Book’ and whose objective was to help the newly elected government to develop an implementation agenda for a transformed education system.

Although the market for education policy research expanded considerably in the years leading up to the first democratic elections in 1994², it seems that many of the major research commissions (outside of NEPI and IPET), and in particular those undertaken by international agencies such as the United States Agency for International Development’s Tertiary Education Sector Assessment (TESA) by-passed the EPU community (Samoff, 1995; Taylor, 1992). Taylor attributes these “missed opportunities” to a lack of critical mass of experienced researchers - who would be able to make the desired impact in the policy field - among the EPU’s. For Samoff, it was clear that several of the major donor agencies had a low regard for the quality of the CSHEs’ work, and had dismissed NEPI as “insubstantial, unrigorous, and far too polemical to be either analytically or practically useful” (1995: 29).

With regard to the general perceptions about the role of research in policymaking during this period, it is clear that, from the perspective of the democratic movement and the newly elected government, research was seen as an important, if not central, element in policymaking (UWC-EPU, 1994). From the perspective of progressive academics in general, and the research community of the EPU’s in particular, there was an ambivalent position, where, on the one hand, the EPU’s were eager to see the products of their research being used in the development of the policies for the new education dispensation while, on the other hand, there was also a growing apprehension to being regarded as playing a ‘hand-maidenly’ role to the incoming government.

2.3 The third phase of policy development: 1995–1999

The central concern in this period was on setting the (policy) agenda for the transformation of the higher education system, which took as its point of departure the principles and values that were outlined during the NEPI process. Part of this agenda-setting exercise was to be achieved through an elaboration of the overall policy framework that would underpin a transformed education system, as well as a process of institution-building that would be realised through the creation of regulatory structures, such as the Council on Higher Education (CHE) and the South African Qualifications Authority (SAQA).

The primary vehicle for the agenda-setting exercise in this period, of course, was the National Commission on Higher Education (NCHE). The NCHE was set up in February 1995 by the newly-elected, and ANC-led, Government of National Unity (GNU) to advise the new government on, among others³:

- ◁ What constitutes higher education
- ◁ The national goals of the (new) system of higher education

² According to Samoff (1995: 29) not less than twenty major studies on education policy research were commissioned by national and international aid organisations in the period leading to the elections.

³ NCHE Proclamation, Government Gazette No. 16243, 1995.

- ◀ The institutional types required by the system, their particular missions, their respective inter-relationships, and their relationships to the state
- ◀ The structures required to govern and administer higher education, and
- ◀ The funding mechanisms for institutions and students in higher education.

The CSHE played a major role both in the conceptualisation of the NCHE. Its founding director, Harold Wolpe, was a key player in the process of developing the terms of reference of the Commission, as well as in the research undertaken for the NCHE⁴. The NCHE reported its findings to President Mandela in August 1996, and many of its recommendations formed the basis for the new higher education legislative framework, namely the White Paper on Higher Education Transformation and the Higher Education Act, No. 101, 1997 (henceforth referred to as the White Paper and the higher education Act, respectively). These two pieces of legislation together formed the pillar of the new government's agenda for the transformation of the higher education system in South Africa.

Besides developing a set of principles that would underpin a new higher education system, namely equity, democracy, efficiency, and development, an important achievement of the NCHE process was to develop a broad consensus around the (higher education) transformation project among the different stakeholders in South African higher education. As a result, different constituencies with competing interests were able to identify with different components of the NCHE's central principles. The NCHE was also a success in that it established a policy consensus that formed the basis for the relative ease with which the policy framework that is contained in the White Paper and the higher education Act gained general acceptance.

Given the history of the apartheid ideology of exclusivity, the NCHE took a conscious decision that its process of developing a framework for the transformation of higher education would have to be consultative and transparent (NCHE, 1996). For Moja and Hayward (2000) this was a crucial decision since it facilitated effective policy formulation in a way that gained the support of most stakeholders, government officials, the higher education community, and the public at large.

What are we to make of the nature and role of policy research during this period? In reflecting on its own role and contribution during this period, the CSHE has stated that the policy development phase leading up to the promulgation of the higher education legislative framework in 1997 was characterised by research whose overwhelming emphasis was on quantitative analysis of trends and descriptive audits, and thus tended towards "theoretical thinness" (Annual Report, 2002: 5). This is not surprising, of course, since one of the key obstacles to undertaking research in the early stages of the policy development process was the unavailability of reliable, and up-to-date, information. Consequently, much of the research that was done in this period - although intended as an input to policymaking, in the last instance - involved a lot of gathering of basic data, which

⁴ The CSHE hosted one of the major research teams of the NCHE, namely the Programmes, Institutional and Qualifications Framework Task Group, and a number of its researchers were active participants in the various working groups of the Commission.

was a time-consuming but necessary task if the key decision-makers were to make sense of the challenges they faced, and given the enormous gaps that existed with regard to information that was available on the higher education system.

2.4 The fourth phase of policy development: Post-1999

The fourth phase of policy development commences with the appointment of a new Minister of Education, Kader Asmal, and also coincided, at the level of the national political scene, with Mbeki's assumption of the presidency of the country – a political era that has been described as 'delivery-focused' by some commentators. A feature of this period was the increasing prominence of the role played by the Ministry in policy decision-making, which saw a concomitant decline of direct stakeholder involvement in policy development processes (Badat, 2003). In contrast to the two previous periods, which were characterised by a relatively 'hands-off' governmental steering approach to system change, there were now more 'directive' policy interventions from the Ministry of Education, in areas such as the restructuring of the institutional landscape, language policy, the regulation of private higher education, distance education, funding, planning, etc.

One of the challenges that Mbeki put to his new Minister of Education was the question: "Is higher education, will higher education be, a system for the 21st century?" (Department of Education, 2000). In response, the Minister of Education turned to the Council of Higher Education (CHE), instructing it to set up a task team that would advise him on the key principles and details of a framework and strategy for the reconfiguration of the higher education system (CHE, 2000). The CHE duly did so, and at the end of June 2000 submitted to the Minister its report, titled: "Towards a New Higher Education Landscape", which is also referred to as the 'Shape and Size' document. Eight months thereafter, in February 2001, the Minister of Education released the National Plan for Higher Education, which was the Ministry's response to CHE's report.

A key initiative that was announced in the National Plan was the establishment of a National Working Group that was to advise the Minister of Education "on appropriate arrangements for consolidating the provision of higher education on a regional basis through establishing new institutional and organisational forms, including the feasibility of reducing the number of higher education institutions"⁵. The National Working Group submitted its report to the Minister of Education early in 2002. The NWG report formed the basis of the Minister of Education's proposals for the restructuring of higher education through mergers, which were later approved by the Cabinet in May 2002.

The following table lists some of the key policy initiatives that were undertaken during this phase, many of which were initiated on the basis of a request for advice from the Ministry of Education to the CHE, and others which the DoE or the CHE did on their own initiative. Some of these, for example on language policy, have already resulted in the adoption of a new policy by the government.

⁵ Terms of Reference for the Ministerial National Working Group, page I.

Table 1: Some of the major policy initiatives in the fourth phase

POLICY INITIATIVE	PROCESS/ACTIVITY	OUTCOME/S
Initiatives on restructuring the higher education institutional landscape (1999 onwards)	<p>Ministry request to CHE to provide advice on restructuring the higher education institutional landscape</p> <p>Release of CHE report: <i>Towards a New Higher Education Landscape: Meeting the Equity, Quality and Social Development Imperatives of South Africa in the Twenty-First Century (2000)</i></p>	Cabinet approves in late 2002 Ministry of Education's proposals to reduce the 36 public institutions to 21 through mergers and incorporations. New 'comprehensive' institution created through the mergers of a university and technikon
To develop a new academic policy for the structure, duration and nomenclature of qualifications and programmes (initiated in 1999)	Establishment of CHE Task Team and production of a Discussion Document in 2001 titled: <i>A New Academic Policy for Programmes and Qualifications in Higher Education</i>	Public comment and steps towards finalisation of New Academic Policy by the Ministry in 2003
Ministerial request to CHE for advice on the criteria and conditions for institutions to use the terms 'university', 'technikon', 'college'	CHE establishes investigation under auspices of its Shape and Size Standing Committee	CHE advice to the Ministry in late 2003
Initiative in 2000 on language policy for higher education with request from Ministry for CHE advice	CHE produces policy advice report for Minister in 2001	Ministry releases <i>Language Policy for Higher Education</i> in late 2002, based essentially on the CHE's advice
Initiative by the Ministries of Education and Labour to review the nature and role of the NQF in higher education (2001)	Ministries jointly establish a Study Team to review the NQF in education, to which CHE and various higher education actors motivate for major changes in the implementation of the NQF in higher education	Ministries' decisions awaited in response to proposals of the Study Team
CHE initiative to review co-operative governance in higher education (2001)	CHE Task Team conducts investigation and releases Research Report and Policy Report with some 20 recommendations for comment	Amendment to Higher Education Act in 2002 to reduce the size of Councils of institutions

Table I Continued

POLICY INITIATIVE	PROCESS/ACTIVITY	OUTCOME/S
Ministerial request for advice on various aspects of the provision of distance education in higher education	CHE establishes a Task Team comprising national and international specialists which conducts investigations on a range of issues	CHE advice to the Ministry submitted in late 2003
Ministerial request for advice on the nomenclature of proposed comprehensive institutions	CHE advises Minister on the nomenclature of proposed comprehensive institutions	Ministry accepts advice that all comprehensive institutions should provisionally be called universities
Ministerial request for advice on the General Agreement on Trade and Services (GATS) and higher education	CHE initiates debate through its journal, <i>Kagisano</i> , commissions work and convenes a national seminar	CHE advises the Ministry in mid-2003

Sources: Badat, 2003; CHE Annual Report, 2002/2003

3 A description of the Centre for the Study of Higher Education (CSHE)

This section will provide a descriptive overview of the organisational dynamics of the CSHE, which will include a discussion of its organisational history, the objectives of its research programme, as well as the issues that led to the shifts in its research programme.

Having discussed the evolution of higher education policy development in South Africa in Section 2, we will now examine in more detail the organisational dynamics of the CSHE. This will be done through a description of its organisational history, as well as through the views of a number of key informants who were associated with the CSHE on the one hand, and the Department of Education's Higher Education Branch on the other. As it was mentioned in the introduction, a decision was made at the outset not to focus on any particular project within the CSHE but to examine research utilisation in relation to the work of the unit as a whole.

Although this section will also examine how the CSHE's work was affected by the changes arising from the broader political and policy climate (which we discussed in the previous section) the discussion will not be structured in relation to the phases that were identified as characterising the policy development process in South Africa. This is because some of the shifts in the research programme and orientation of the CSHE were in response to developments and dynamics that were internal to either the organisation itself, or the university at which it is located.

3.1 Organisational history of the CSHE

The CSHE started its life at the beginning of 1992, although the agreement that formalised its establishment was signed in September of the previous year. Like the other EPU that preceded it, the then CSHE was established as a 'joint creation' of the University of the Western Cape (UWC) and the National Education Co-ordinating Committee (NECC).

The NECC established the EPU's in order for them to provide it with 'intellectual ammunition' in its broad-based struggles against apartheid education.

Although the CSHE was formally established as a joint project of the NECC and UWC, it was in reality constituted through the partial merger of the Research on Education in South Africa (RESA), a project that was based at the University of Essex in England, and the Research and Training Project on Education in South Africa (RETPESA), an initiative of the democratic movement that was located at UWC (UWC-EPU, 1991). In this regard, the CSHE differed from the already existing EPU's at the Universities of Natal and the Witwatersrand in that it began part of its life outside of South Africa and, secondly, came into being as a result of a merger of two already-existing entities.

Like its sister organisations, the CSHE was also formed in the crucible of the anti-apartheid struggle as a vehicle for the MDM to begin focussing its attention on the exploration and development of alternative policy options, in anticipation of a post-apartheid education dispensation. Although one of the founding principles of the EPU's was that their 'parent' institutions - namely their host university and the NECC - would share the responsibility for obtaining the necessary funding that would ensure their sustainability. However, the reality was that neither the universities nor the NECC was able to raise their share of funding for the EPU's' operating income, and, consequently, both institutions increasingly had a declining influence in the affairs of the EPU's. The EPU's obtained the largest share of their operating income from foreign funding sources. For example, by 1994 the funding from foreign donors (as a proportion of all income) stood at 84.5% at the University of Natal's EPU, 57% at the University of the Witwatersrand's EPU, and 54.7% at the CSHE (Samoff, 1995).

Since its inception in 1992, the CSHE has had three Directors, namely Mr Harold Wolpe (1992-1996), Prof Saleem Badat (1999-2000), and Prof George Subotzky (2001 - present); in addition, following the sudden death of Harold Wolpe in 1996, the CSHE had two Acting-Directors, namely Mr Glen Fisher and Dr Mignonne Breier, between 1996 and 1999. In 2002, the year it celebrated its 10th Anniversary, the CSHE changed its name to the Centre for the Study of Higher Education (CSHE).

3.2 Objectives of the research programme

The general objectives of the CSHE, as set out in its constitution, are to (Education Policy Unit, 1991: 5):

- ◀ Conduct high-level theoretical and empirical research on alternative education policies that may contribute to the transformation of the higher education system in South Africa
- ◀ Analyse higher education policy issues in relation to the existing institutional order and social structure and to strategies of economic and political reconstruction and development
- ◀ Publish and disseminate research findings both in academic publications and in popular form, and
- ◀ Train, particularly black, researchers in order to build and strengthen capacity in the field of higher education policy research and analysis.

The CSHE, from its inception, regarded its research orientation to be derived from a critique of the positions that were commonly held in political and educational circles in South Africa at the time. It saw itself as transcending the oppositional mode of research that was characteristic of the politics of the period leading up to the release of Nelson Mandela in 1990 (UWC-EPU, 1991). The theoretical approach underpinning the research orientation of the CSHE sought to highlight the importance of analysing the relationship between education and the social-structural and institutional conditions of South African society.

For example one of the objectives of the research programme of the CSHE was to examine [] *to what extent, if at all, and in what way, the alternative education policies contribute to the construction of an education system appropriate to, and supportive of, institutions and social structures of a democratic, unitary, and non-racial post-apartheid South Africa. (UWC-EPU, 1991: 10)*

In this regard, the CSHE, especially in its formative years, saw itself primarily as a research organisation that was focusing on the analysis of policy alternatives or choices, rather than embarking on the development of concrete policy propositions for higher education transformation. Consequently, the CSHE was at pains to emphasise this distinction, stating that:

[] *it is not part of the role of the Unit to define and promote education policies other than through the assessment of policies proposed by the relevant actors in the field of education. [The] purpose [of the [CSHE]'s research programme] is...to provide the democratic movement and, in the future also a democratic government, with knowledge which will be pertinent to policy formation. (UWC-EPU, 1991: 13)*

3.3 The research programme of the CSHE

The early research programme sought to balance two distinct orientations. The first, which was a consequence of the founding Director's own academic background and grounding in a particular theoretical and scholarly tradition, was the need to conduct research that was located within the broader field of critical/political sociology, in that it sought to examine and interrogate the effects of specific (higher education) policy reforms on the wider social order, especially the extent to which particular reforms either reinforced or reproduced social or institutional inequalities, or transformed the prevailing social order (UWC-EPU, 1991). At the time, it was envisaged that much of the research and scholarly output of the CSHE would contribute to enhancing its academic reputation.

Much of the CSHE's research output between 1992 and 1997 can be divided into two broad types: the first was research with a strong theoretical/analytical bent, and whose objective was to help shape the early debates on the nature and direction of the South African higher education transformation project. Seminal among these were contributions on the future role of historically disadvantaged institutions in a post-apartheid higher education dispensation, on the policy framework and principles that ought to underpin a transformed higher education system, and on addressing the tension between the need for equity with the imperative of development. The other type of research was largely of a descriptive kind, and was geared towards providing a more comprehensive picture of the

higher education landscape, especially in relation to providing data that was hitherto not available, for example on the historically disadvantaged institutions, or information that was not easily accessible from South African Post Secondary Education (SAPSE) system. Most of this research fed into policy development initiatives such as NEPI and the NCHE.

The first key publication of the CSHE was a working paper with the title: ***The Post-Secondary Education System: Towards Policy Formulation for Equality and Development***⁶, which sought to analyse and theorise the “problematic relationship” between equality and development, two of the central principles of the transformation programme of the progressive movement at the time (UWC-EPU, 1993: 5). The “equity and development” problematic framed much of the early research of the CSHE, especially the major commissions it undertook for the CEPD⁷ and the Forum for the Vice-Chancellors of Historically Black Universities⁸. Thus the central focus of the CSHE’s formative research programme was to

[] establish the factual and analytical foundations for policies which, on the one hand, advance gender and race equality in access to post-secondary education and also serve to reduce the inequalities between black and white institutions and, on the other hand, contribute simultaneously to the production of the human resources needed to give effect to a development path for a democratic South Africa. (UWC-EPU, 1993: 6)

The CSHE later conducted two research projects that were commissioned by the new Department of Education. The first project, which was undertaken in 1999, focused on international student and staff mobility into South Africa, and examined academic linkages between South African higher education institutions and higher education and research institutions in Africa⁹. The objectives of the research project were to examine and determine the flows of students and staff from other parts of Africa into the South African higher education system, and the extent of academic collaborations and linkages between South African institutions and their counterparts on the continent. A further objective was to examine these trends in the light of relevant policy options regarding access, equity, and human resource development in the southern African region. The report was submitted to the Department of Education in November 1999.

The second commissioned project, whose title was: ***The Emergence of Private Higher Education in South Africa: Key Issues and Challenges*** was undertaken in 2000. As the title indicates, the project sought to provide an overview of the then nascent private higher education sector, in particular with reference to its size and the nature of its programmes and qualification offerings.

⁶ Badat, S., Barends, Z., & Wolpe, H. (1993) *The Post-Secondary Education System: Towards Policy Formulation for Equality and Development*.

⁷ Education Policy Unit (1994) *Draft Policy Proposals for the Reconstruction and Transformation of Post-Secondary Education in South Africa*.

⁸ Badat, S., Fisher, G., Wolpe, H. et al (1994) *Differentiation and Disadvantage: The Historically Black Universities in South Africa*. EPU Research Report.

⁹ UWC-EPU (1999) *International students and staff at higher education institutions in South Africa and academic linkages between local institutions and higher education and research institutions on the African continent*.

The other objectives of the project were to (Mabizela *et al*, 2000):

- a) Examine international trends with a view to drawing out lessons for South Africa and to identifying the likely future direction of private higher education in South Africa
- b) Analyse the prevailing local conditions which fostered the proliferation of private higher education institutions in South Africa
- c) Identify the likely impact and potential contribution of the private higher education sector to the higher education system as a whole, both as a complementary partner, or a threat, within the overall development of human resources in South Africa; and
- d) Highlight key policy considerations.

The CSHE also saw its research programme as contributing to the creation and development of a body of knowledge that would be of assistance to the democratic movement – which was led by the ANC – in its process of formulating policy options that would underpin the establishment of a transformed higher education system. In this regard, the CSHE saw its research programme as playing a role in influencing policy at the level of ideas, especially since the policy terrain at the time was in a state of flux, and was characterised by a high degree of uncertainty (Weiss, 1991).

However, for reasons that had to do partly with a lack of capacity, as well as with the demands of working in a pressurised (political) environment, the CSHE had difficulty in adequately fulfilling this mandate. As a former Director of the CSHE has put it:

[the CSHE's research objective] was really about informing the policy development process of the ANC in the main, as the government-in-waiting. Within the [CSHE] there was also the notion of really just contributing to debate around higher education issues and building [a] culture of intellectual production in higher education, which is a very limited thing in South Africa. And then thirdly, I suppose, it was really contributing to scholarly debate and intellectual production, in terms of writings in journals and books, and so on.

I think the [CSHE] initially struggled to find that balance between consultancy/contract research – showing yourself to be relevant to the needs of transformation – and then on the other hand justifying your presence at an institution of higher education, in terms of contributing to scholarly debate (from interview, 14 October 2003)

This tension that the former Director is referring to has been a constant theme throughout the early history of the CSHE. The CSHE had to constantly strike a balance between being relevant to the goals of (higher education) transformation on the one hand, and justifying its location within an institution of higher learning, on the other. The first challenge arose from both its political responsibility - as a creation of the NECC – to provide 'intellectual support and ammunition' to the democratic movement as well as an expectation that, as a policy research unit with progressive credentials, is had a role to play in the unfolding policy development process. The other obligation, of course, arose from the fact that, as a research organisation located within a university, the CSHE was expected to contribute to scholarly research and the production of new knowledge.

This is a tension that has confronted other EPU's as well, and one which many of the progressive policy research units (covering sectors such as health, urban planning, energy, etc.) that were set up in universities in the eighties also had to address. It is a tension whose resolution, Muller (2000) has argued, has eluded the EPU's as they have become paralysed in trying to balance the two opposing demands and expectations between 'intellectual work' and 'reconstructive work'. For Müller (2000: 279) such a balancing act, "however desirable it may be, simply cannot be sustained". And this is because

[t]he more that policy work drives toward planning and implementation, the less can it entertain doubts about its constitutive grounds. (Müller, 2000: 278)

The CSHE sought to resolve this tension by continuing to serve as a research resource to organisations of civil society who were not affiliated to the MDM, in addition to developing its own research programme, which grew independently of either the policy needs of the ANC or of the civil society formations themselves. In reflecting about this tension, the Prof Subotzky has noted:

We were always, right from the beginning, always cautious about being labelled, or seen, as 'handmaidens' of [the new democratic] government. We also wanted to preserve our identity as independent researchers, and in that sense, (being) able to criticise, and reflect, on government (George Subotzky, interview, 21 October 2003)

Consequently, one of the central policy issues that the CSHE sought to interrogate was the "problematic relationship" between equity and development, both of which were key policy goals that were seen by the new government to be underpinning the transformation of the higher education system. In other words, the early research programme of the CSHE sought to establish how the proposed policies from the democratic government sought to balance the inherent tension between the need to promote equity issues, for example, the promotion of gender and race issues in relation to access to higher education, or the reduction of institutional inequalities between historically black and white institutions – while also contributing to (human resources and, in turn, economic) development.

Whilst insisting on maintaining its independence from the clutches of the democratic movement, the CSHE could, however, not entirely stay aloof of the nascent policy development processes. As it was mentioned in the previous section, the establishment of the Centre for Education Policy Development (CEPD) in late 1992 saw the EPU's getting more involved in research projects that had a more direct link to the formulation of policy proposals for the new education dispensation. Through its participation in policy development initiatives of the CEPD and other agencies, the CSHE was able to consolidate its reputation as a major higher education policy research unit within a very short period, so that by early 1994, it had become the main resource on higher education policy research and analysis for the ANC Education Department and the CEPD (UWC-EPU, 1994).

Samoff (1995: 61) states that the CSHE made "important contributions to the reconstruction of post-secondary education in South Africa" and that the "market

assessment of the quality of the [CSHE]'s work is generally - though not entirely - positive". Samoff (1995) further noted that a number of influential people in the higher education sector at the time, including the Minister of Education (Prof Sibusiso Bhengu) the Department of Education's most senior civil servant, and the Chairman and Executive Director of the NCHE, all spoke highly of the CSHE's work.

A weakness of the CSHE during this period, which had implications for its research productivity, was the lack of a critical mass of senior and experienced researchers. As one of the central objectives of the CSHE was to recruit and develop a cadre of young black researchers, various training approaches were adopted to develop their research capacity. However, these initiatives were generally unsuccessful because of a shortage of experienced researchers who could mentor the trainees. In this regard, a former researcher at the CSHE has made the observation that:

[] there were real tensions in trying to build a unit that was, itself, going to be a kind of an exercise in transformation and empowerment, by bringing in young staff who didn't have the necessary qualifications and formal training and experience; and not the sort of people with the necessary [research] background.

We didn't say: "what do we do to become a really serious, high quality, professional, research outfit. How do we provide that high quality training and experience so that we bring black researchers and make them experts." At the end of the day, I think a disservice was done both to black staff who came in on that basis, because they didn't get the training they should have had, and the disservice was [also] done to the research agenda, in terms of the quality of the work that was produced (from interview, 23 October 2003)

Prof Müller, who has been a member of the Management Committee of the CSHE since its inception, has also observed that:

[] the [CSHE] ever really managed to attract top researchers which could really get it going. It had really good people. But what you needed to really lift [its] profile, in my view, were a number of top people. Research is very difficult. I understand the research culture very deeply as being pulled. You need models and mentors to develop a young research outfit. You can't push it with incentives. And I found - even when I was at the Wits EPU - that it's extremely difficult to train people properly because of the nature of contract research and the deadlines. I had the view that, from 1990, the universities have to do the training, and that research units had to recruit the best people. But they (EPUs) have persisted in taking in young people and trying to train them there, and I think that's very difficult (Joe Müller, interview, 20 October 2003).

3.4 Changes in research orientation

There have been two shifts in the CSHE's research focus and orientation since its inception in 1992. Both of these shifts unfolded over a period of five years, between 1997 and 2002. The first shift, which took place towards the end of what we referred

to in the previous section as the 'third phase of policy development (1995-1999)', reflected a change of focus for the CSHE research from its concern with macro-level policy analysis to an examination of the effects of national policy at the institutional level. Following the promulgation of the higher education framework into policy through the passing of the White Paper on Higher Education Transformation and the Higher Education Act in 1997, the CSHE realised that the changing higher education legislative environment required it to

[] take up the challenge represented by the shift from policy formation to policy implementation, both in terms of contributing to the development of implementation frameworks and strategies, and developing the capacities pertinent for this new work. (UWC-EPU, 1999: 14)

Prof Subotzky has also commented as follows in this regard:

I think that there was an initial emphasis on research for policy - and in my reading particularly - building the whole macro-framework of education policy, leading up to that period around 1996/7; and once the NCHE had done its work, the White Paper, and so on, [] then from then on the focus [shifted to] other kinds or elements of policymaking and the change process, and I think particularly looking a little more towards institutional-level change and the range of responses of institutions to the macro-policy framework. A number of our projects are looking at that level (George Subotzky, interview, 21 October 2003)

The second shift, which occurred almost simultaneously with the one described above, is with regard to the changing orientation of the CSHE's research programme from a focus on research 'for policy' towards an emphasis on research 'of policy'. This shift to a form of research orientation that is infused with a sociological perspective, and an increasing engagement with higher education as an academic field of study, has been described by Prof Subotzky in the following way:

I think there's a slightly broader range of what I'm calling scholarship in higher education studies, which is slightly broader, but has a policy import, but is studying higher education as a phenomenon, and it kind of draws out the policy implications. That is, I think, the broader kind of shift (George Subotzky, interview, 21 October 2003)

Furthermore, this shift seems not only to have been in response to the changes in the broader policy climate, but also a manifestation of the changes in the research orientations of those in leadership within the CSHE, as Prof Subotzky has again attested:

I think it's true to say that Harold Wolpe, as the founding Director, was very steeped in political economy and development economics, and that kind of thing, but he wasn't actually a higher education scholar, so he wasn't an educationist in that sense; that was not his disciplinary background I think that under [Badat's] directorship some of these strategic shifts began to happen. So I think [Badat] did that, you know the whole idea of higher education studies and this notion of institutionalisation [of higher education studies] was his initiative, it got borne with him, as it were (George Subotzky, interview, 21 October 2003)

The institutionalisation of higher education studies as an area of academic study also forms part of the second shift. This is seen as a shift away from a “consultancy-driven, Mode-2 oriented research, at the development/policy periphery”, towards the “disciplinary heartland of the academy” (CSHE, 2003: 6). According to Subotzky (2002), the consultancy-driven research had given rise to a “theoretically thin” research that did not add to the stock of scholarship on higher education studies. This shift - which, in Terenzini’s (1996) terms is characterised as a displacement of the scholarship of application with the scholarship of discovery and integration - would not be embracing higher education scholarship for its own sake, but would be a project that retains an explicitly political and transformative agenda. As Prof Subotzky puts it:

[] in forging our new identity as a centre, we’ve been clear that we don’t want to model ourselves on some of the American centres which we would distinguish ourselves from in terms of a political agenda... of transformation and upholding the values underpinning the new democracy (George Subotzky, interview, 21 October 2003)

However, a different reading of these two shifts (which is the author’s interpretation of these developments as a former ‘insider’¹⁰) would characterise these shifts as also a response to, or a culmination of, key developments that were internal to the CSHE. The first development followed the sudden death of Harold Wolpe (the founding director of the CSHE) in early 1996, which precipitated the establishment of a working group by the UWC Senate Academic Planning Committee to consider the future of the CSHE. There were also other reasons that were given by the Academic Planning Committee for the enquiry, and these were that (UWC-EPU, 1999: 11):

- ◀ The demise of the NECC invalidated the constitutional basis of the CSHE
- ◀ It was regarded as anomalous that a major research unit such as the CSHE was operating outside of the academic and faculty structures of the university, and
- ◀ The political and higher education context that had changed since the establishment of the CSHE in 1991 required an appraisal of its founding objectives.

The main recommendation of the Working Group was that the CSHE should be located within the university’s Faculty of Education, and become directly involved in the teaching programme of the Faculty. While the identity of the CSHE as “fundamentally a research unit” that would continue to “conduct policy research in post-secondary education” was recognised, the Working Group’s recommendations also emphasised that the CSHE would also have to develop a programme of “scholarly research” (UWC-EPU, 1999: 12). The University Council subsequently endorsed the recommendations of the Senate Working Group.

¹⁰ Tembile Kulati worked as a researcher at the UWC-EPU from its inception in 1992 until 1997.

The CSHE revised its organisational objectives to give expression to the Senate Working Group's recommendation following the Council decision. The constitution of the CSHE was consequently amended to include the following objectives (UWC-EPU, 1999: 13):

- ◀ To contribute to the institutionalisation of the academic fields of education policy studies and higher education studies through collaboration and co-operation with other academic and research organisations and institutions; and
- ◀ To contribute to the education and training of students, particularly from historically disadvantaged social backgrounds, in the fields of education policy studies and higher education studies.

In other words, one can also interpret the two shifts referred to earlier as having been precipitated not so much by a response to changes in the external (policy) environment, but also, if not primarily, by dynamics that were internal to the university. So the shift from 'research for' to 'research of' policy – that is, the decision to focus on higher education policy as a scholarly endeavour – can be read as flowing directly from the Senate decision.

Another development that was linked to the second shift was a five-year research and organisational development grant that was obtained by the CSHE (as part of a nation-wide consortium of policy research units) to undertake long-term critical research in higher education. This grant, according to the CSHE, would free its researchers from the "consultancy treadmill", allowing it to realise its vision of becoming "a recognised centre of critical scholarship in the field of higher education policy studies" (CSHE, 2003: 9).

Furthermore, the immersion of the CSHE's research within the field of higher education policy studies will, according to Prof Subotzky, unshackle it from its national / domestic moorings, thereby gaining it a wider audience, such that:

[] somebody sitting in Bulgaria or at the Centre for Higher Education Policy Studies (in the Netherlands) will find our work interesting, since it will not be bounded by the current, or narrow, national dimension (George Subotzky, interview, 21 October 2003)

3.5 The current research and teaching programme of the CSHE

The previous section has already discussed some of the major shifts in the research orientation of the CSHE, and in so doing, touched on aspects of nature of the research currently being undertaken. According to the Director, the mode of knowledge production varies from what could generally be described as 'strategic research', towards research that is more scholarly, some of which retains a policy emphasis. He has described strategic research as one:

[] which relates to particular kinds of longer term transformations and applications, so in that sense one could broadly locate research, both for, and of, policy. It has some kind of an instrumental, or external, purpose to it (21 October 2003)

Research clusters and projects

There are four thematic clusters in the current research programme of the CSHE, in the following areas:

- (i) access, equity and inclusion;
- (ii) knowledge, knowledge application, and ICT;
- (iii) institutional culture and higher education change, and;
- (iv) special topical issues.

Some of the research projects that fall within these themes are the following:

- ◀ Access, Equity and Inclusion
 - ◆ The Implementation of the Recognition of Prior Learning (RPL) in South African Higher Education
 - ◆ Inclusive Education: Ensuring Equitable Access and Success among Students with Disabilities
 - ◆ Deracialising the Academic Heartland: Case Studies of Five Higher Education Institutions
- ◀ Knowledge, Knowledge Application and ICT
 - ◆ The Contribution of Higher Education Development: Investigating Modes of Knowledge Production and Developing Appropriate Research Capacity-Building Models
 - ◆ The Innovative Application of ICTs in Higher Education
 - ◆ A Survey of Innovation in African Higher Education
- ◀ Higher Education Change
 - ◆ Reconfiguring the Higher Education Institutional Landscape: Case Studies of Strategic Management in Higher Education Institutions
 - ◆ Improving Student Access and Success through Enhanced Leadership and Management in Higher Education
- ◀ Topical Issues
 - ◆ Staff Retention and Remuneration Levels at South African Universities and Technikons
 - ◆ Operationalising Institutional Redress in South African Higher Education
 - ◆ The Dynamics of Aid to Education and Training in Africa

The Masters programme in Higher Education Studies

In January 2002 the CSHE, in conjunction with the Faculty of Education at UWC, launched a Masters degree programme in Higher Education Studies: Policy Analysis, Leadership and Management (PALM). The objective of the Masters degree programme is to develop capacity by equipping its participants with an academically based understanding of the changing context of higher education (CSHE Annual Report, 2003). The programme has received considerable funding from the Ford and Rockefeller Foundations.

The programme registered 18 students in its first year of operation, some of who were in the post-graduate diploma stream. In addition to CSHE researchers presenting modules on areas such as curriculum transformation in higher education, the changing higher education workplace, student equity, access and diversity, etc., the programme has had a

number of visiting lecturers from neighbouring institutions as well as a number of prominent international scholars.

Staffing and capacity building

In 2003, the CSHE had a staff complement of 15 members, 10 of whom were researchers, and the rest administrative staff. Four of the staff members had PhDs, and three were registered PhD candidates.

Although the development of capacity in higher education policy research remains one of the central objectives of the CSHE's mission, a number of training interventions and programmes that were initiated over the years have not been successful. An internship programme that was partially funded by the National Research Foundation has been discontinued, although it is not clear what the reasons for the discontinuance are (CSHE Annual Report, 2002). A strategy that is being considered is to re-establish the internship programme – possibly with recruits from the PALM Masters programme - once the CSHE has developed a sufficient research expertise at senior level. The CSHE is also developing an exchange programme with international research centres for its staff.

International linkages and networks

The CSHE has developed a number of linkages and research networks with international organisations and research institutions. For example, in 2002 it hosted a workshop on the Public Role of African Higher Education in conjunction with the Social Science Research Council (SSRC) of New York and the African Association of Universities (AAU).

The CSHE has also been a participating centre in an international initiative called the Project on Private Higher Education (PROPHE), which is co-ordinated by Daniel Levy from the State University of New York (SUNY) in Albany. The CSHE will contribute quantitative and qualitative data to this project, which seeks to track international trends in private higher education.

There are also links with the University of Bergen in Norway through a collaboration that is funded by the South Africa-Norway Tertiary Education Development Programme (SANTED). Currently, the project being undertaken under this linkage is the one titled: Improving Student Access and Success through Enhanced Leadership and Management in Higher Education.

3.6 Funding

The CSHE received a total of R4.6m in grants in 2002. Together with the six members of the Education Policy Consortium (EPC), which consists of the Education Policy Units at the Universities of the Witwatersrand, Fort Hare, Natal, and UWC, the Centre for Education Policy Development (CEPD), and the Centre for Education Research, Evaluation and Policy (CEREP) at the former University of Durban-Westville, the CSHE has recently received a major cash-injection from a five-year programme on research and organisational development. As part of this grant, which is funded by the Swedish International Development Agency (SIDA) and the Dutch government, the CSHE will

receive approximately R3.6m over five years, comprising R2.4m for research, and a further R1.2m for organisational development (CSHE Annual Report, 2002).

4 On the utilisation of research in policymaking

4.1 Who are the intended users?

The special circumstances of the establishment of the CSHE as a joint project of the University of the Western Cape and the National Education Co-ordinating Committee brought with it a number of responsibilities and obligations. At the level of research utilisation, this emerged as a tension that found expression as a need for the research products of the CSHE to find ‘use’ by providing support to the nascent policy development process, on the one hand, whilst also making a contribution to the emerging scholarship on higher education studies - through publications in scholarly journals – on the other. There was also the added expectation that the CSHE would help inculcate a research culture at the University of the Western Cape, being located as it was at a historically disadvantaged institution of higher learning that had had a legacy of a poor research output.

A former Director of the CSHE has captured the dynamic arising from these responsibilities as follows:

I think right from the outset the work of the [CSHE] was meant to be addressing multiple audiences, and its utilisation was meant to be for different kinds of purposes. So if you look at the [CSHE] itself it had a notion of really contributing to a transformation process, and in the early nineties this was really about informing the policy development process of the ANC in the main, as the government-in-waiting. Within the [CSHE] there was also the notion of really just contributing to debates around higher education issues and building that kind of culture of intellectual production in higher education, which is a very limited thing in South Africa (14 November 2003)

The policymaking domain

Although the domain of policymaking is represented by more than just the views of government bureaucrats, our discussion here will only focus on the perspectives of officials from the Department of Education who were interviewed. From the interviews with DoE officials as well as with the Director of the CSHE, there have only been two commissions to the CSHE from the Higher Education Branch of the DoE since 1997. The first was a project on SADC students studying in South Africa, and the second on the size and shape of the private higher education sector in South Africa. Our purpose is not to discuss the details of the two projects but to draw out some of the issues relating to utilisation arising from these commissions and other interactions that the CSHE has had with the DoE.

A view that has been expressed by a senior official in the Higher Education Branch of the DoE is that the CSHE lacks researchers of sufficient experience and/or competency in the areas that his division requires. This has led the Department to rely increasingly on

overseas experts (especially from the UK and Australia) to assist it in developing the new funding formula, for example. According to the official:

I don't think the Education Policy Unit has got the capacity to do the work we require. The work that my section has commissioned outside has been very technical work around the funding formula - which needs very specialised, technical, skills - in fact; there are very few people with those skills in the country (3 December 2003)

The challenge now facing the Ministry of Education, in the view of the official quoted above, is to translate the higher education policy framework into concrete interventions that have to be driven internally by the Department of Education. This has given rise to a new modus operandi with regard to the internal functioning of the Department, whereby it has identified a number of people with relevant expertise from higher education institutions to work within the Department. These experts are now being hired as technical consultants or managers of projects that the Department undertakes internally, be it the various task teams that it has set up in areas such as the institutional mergers, or in the development of post-National Plan policy initiatives such as the National Higher Education Information and Applications Service.

Furthermore, there is a perception within the DoE that the CSHE, by putting inexperienced researchers in charge of the two projects the DoE had commissioned, had displayed poor judgment, which led to the submission of reports that did not address the policy concerns of the Department, and/or betrayed a lack of understanding of the nuances of policymaking. In this regard, another senior official in the Department has commented that:

The dilemma is that the person who does consultancy work for you, coming from the outside, more often than not does not have the nuanced understanding, does not have the depth, that your job actually gives you in terms of studying the problem. So you more often than not, receive reports which... yes are useful, but you sometimes feel that: "Gee, I wish [they] would have had time to drill further down because, actually, I'm being told something that I already know."

I suspect it comes back to the fact that as the Department matures and tries to ensure that it itself is a knowledge organisation, it applies intellectual rigour as far as possible in terms of what it does, [with the result that] its expectation of commissioned work also goes up. Because we then say: "Tell us something we don't know. Don't tell [us] something that [we] already know."

The view expressed above sees the non-utility of research as stemming from a lack of understanding – an understanding that comes with experience in policy development processes – of the challenges of governing by the researchers. It is a view that, although similar, is distinct from the 'two communities' theory that is associated with the work of Caplan (1979; 1991).

The 'two communities' theory seeks to explain the under-, or non-utilisation, of research from the perspective of the relationship, or the 'cultural gap' that exists between researchers and policy-makers as two distinct communities. According to Caplan (1991) the cultural gap between social scientists and policy-makers is a consequence of differences in values, language, reward systems, social and professional affiliations of the two social groups. Thus the problem of under-/non-utilisation can be attributed to the incompatibility of the socio-cultural and behavioural worlds that are inhabited by these two communities. The following quotation from Prof Saleem Badat, the Executive Director of the Council on Higher Education (CHE) captures this view succinctly:

Can academics in general, and this includes researchers in policy units only take policy research so far, and cannot take it beyond a certain point? There's something that's called imagination, intuition, ability to reach a political situation strategically, a sense of what will work, and what won't work, and so on – that is lacking amongst the [work] we [have] commission[ed].

Perhaps to be fair to those that we commission: they do not operate in this realm, and maybe they should not operate in this realm. They can only take it to a certain distance, and put forward tentative ideas forward, and perhaps they do the best they can do when they put forward those proposals and recommendations. But especially at that level, it doesn't feel useful at all. And that's especially where we have to do a lot of work, because really, at the end of the day a brilliant analysis...because, you know, the Minister will say: "This is really good stuff but where's the proposals, where's the recommendations?" That's what we find we have to do a lot of work around.

Let's just say I've seen too much work that has not helped in that really important arena of the policy proposals and the recommendations; perhaps it has to do with the fact that it's a different arena of work altogether, which, maybe, most academic scholars cannot do. There are some who do - there are some consultants who can do that – although] there tends to be more consultants than academics who can do that (Saleem Badat, interview, 14 November 2003)

The two communities theory has found support in the higher education literature, as it is illustrated by Birnbaum's (1998) paper, which goes by the title: '**Policy scholars are from Venus; Policy makers are from Mars**'. Furthermore, Reimers and McGinn (1997), in their study on education research and policy change in developing countries, have also endorsed the basic thesis of the two communities theory, arguing that:

[] the poor coupling between education research and decision-making stems from the differences in the backgrounds of researchers and decision makers, differences in their social values, and differences in institutional settings. (Reimers and McGinn, 1997, quoted in Nielson, 2001 6)

Another explanation that has been provided for the lack of utilisation of research in higher education policymaking is that policy researchers and research organisations have failed,

or been very slow, in responding to the shifts in the higher education policymaking process, especially the one from the third (the agenda-setting) to the fourth (the implementation) phases. For Prof Badat part of the explanation for the lack of research influence on policymaking may lie in the fact that:

[] *research institutions have not read the shifts, and have not seen the signals that we are going to be moving from a concern with macro/big policy statements and visions towards much more concern about how the hell do we make these things work now. And maybe a weakness in this overall enterprise is in terms of where we come from, and what we have been schooled in, that is, critique. And maybe it takes a bit more time and it's more difficult to get practice in a different mode of working, which, you know, is not about abandoning being critical; it's about simultaneously being reconstructive and critical... I suspect that research institutions and individuals have to ask themselves to what extent they have read the context sufficiently, and what it has meant for their work (Saleem Badat, interview, 14 December 2003)*

The intellectual/academic domain

The CSHE has always identified as one of its main objectives the production of new knowledge that would contribute to the scholarship on higher education studies. As mentioned in the previous section, this objective has become more prominent on the CSHE's agenda as it has moved from what it calls the "consultancy-driven, 'Mode 2-ish' and policy-oriented periphery" towards the "disciplinary heartland of the academy" (Subotzky, 2002: 5). Consequently, as it has sought to become "a recognised centre of critical scholarship in the field of higher education policy studies"¹¹, there is a realisation that the CSHE faces an enormous challenge in developing a body of intellectual work through publications, especially in refereed journals. Prof Subotzky has acknowledged this shortcoming:

[] *in terms of publications output there's always been a struggle. We know that we should be taking more of the findings of project work and writing them up. That's been hard, it's always hard - the finding of the time to do that... people are not succeeding to do that - to finish a big project and say, well, it's done for, and now let me write it into an article (George Subotzky, interview, 21 October 2003)*

This is a view shared by a member of the Management Committee of the CSHE, whose feeling is that the centre has not played an influential role in the intellectual/academic domain because it has struggled to translate its research output into journal articles:

I've tried to argue that [the CSHE] should write up their reports and get peer commentary. At the moment, what happens with a lot of NGO research is that it ends up in a report and doesn't enter the knowledge mainstream. So a) it is never evaluated by peers and b) it doesn't contribute to discernible knowledge accumulation. So it is 'marketised'. It becomes a service, and its utility is exhausted in its delivery, it never functions as a knowledge object by being critiqued, circulated, and accumulated. So you

¹¹ Centre for the Study of Higher Education, 2002 Annual Report, page 6.

undercut your own value if you don't have a certain level of acceding to the demands of the knowledge community (from interview, 20 October, 2003)

4.2 Mode of knowledge use

There is broad consensus that the EPU's in general played a major role in what was referred to in the first section as the first (pre-1990) and second (1990-1994) phases of the policy development process, especially in contributing to the debates and background research work of the NEPI and NCHE processes. Two models of knowledge use emerge from the interviews depending on the phase of the policymaking process that one is looking at. The enlightenment model of knowledge utilisation can be discerned from the views expressed by Prof Subotzky who has pointed out that:

[] some [research] gets put out, and then it gets read, and then it gets responded to. It's hard to measure that stuff, and I think that it does contribute to debates and that kind of a thing. And it would not be fair to ask the question in the sense of limiting it too strongly to a whole instrumentalist notion of research (George Subotzky, interview, 21 October 2003)

The above sentiment has also been expressed by a former acting-Director of the CSHE, whose view is that

[] notwithstanding my criticism about the lack of hard research, [the CSHE] was playing a very important role at the very formative and early stage [of policy development] ... I think in terms of influencing discourse, the language that was being used, the concepts that were being worked with, problematising some of the issues around equity and development – those sorts of things – I think the [CSHE] had quite an important influence, [though] not only directly traceable and measurable, but an important influence on the kind of general debates and the issues being discussed.

So I think that the fingerprints of the [CSHE] can be found all over the pages of the NCHE report, but it would also be a mistake to kind of attribute that, in any simple way, to Harold and the [CSHE], because there were other important contributions (from interview, 23 October 2003)

The above comments are in accordance with Weiss' (1977; 1980) notion of how social research diffuses into the policy sphere in an indirect, and barely discernible, manner. As Weiss has put it:

[] much of this use is not deliberate, direct, and targeted, but [is] a result of long-term percolation of social science concepts, theories, and findings into the climate of informed opinion. (Weiss, 1977: 534)

However, there have also been some strong views expressed with regard to the under-utilisation of the research produced by the CSHE in policymaking, especially since 1999, a year that signalled the shift from policy development to the policy implementation phase.

Indicative of this perspective are the remarks made by the head of one of the statutory councils who, in reflecting on the research output of the CSHE over the past few years, has observed:

The [CSHE] [] hasn't produced much [] that has asked or propelled anyone to sit up and take notice, whether in the CHE, or in the Ministry [] For the last few years I have not seen anything, I have not read anything, I have not been highly persuaded or changed my ideas about anything that the [CSHE] has produced. And very little has ever entered into any of the policy advice or the work we've done that has quoted or referenced the [CSHE]. Perhaps it's a particular moment that they're in, perhaps their focus has shifted, I don't know. But there's very little that I have seen, in the last few years, that has come out from the [CSHE] (from interview, 14 November 2003)

The view from the Department of Education is unfortunately even less complimentary, judging by the remarks of one of its senior officials:

The [CSHE] [] may as well not exist. I mean, when I want something I don't think: "[CSHE]"; it doesn't come to mind. I mean even in terms of the [higher education] restructuring process, where was the [CSHE]? (from interview, 3 December 2003)

However, this is not to say that the DoE takes a dim view of policy research in general, or does not take it into consideration in making policy decisions, as Ms Nasima Badsha, the Deputy Director-General responsible for Higher Education, has pointed out:

I think that some form of investigation has informed or underpinned all the major policy initiatives [of the Department of Education]; whether you want to define it strictly as research is another question. Clearly there's never enough time to filter everything that comes through, and then drill down. Often it remains at a fairly superficial level. You know it's there, until you need it and then you drill down [] I pick up on stuff through other networks like COHORT¹², where I first picked up on the Mouton work (on the ageing academic workforce). Then seminars; international stuff I pick up through THES (Times Higher Education Supplement), and through internet sources .(Nasima Badsha, interview, 3 December 2003)

Again, this echoes Weiss (1977), who has observed that:

[] the policymaker himself is often unaware of the source of his ideas [] Bits of information seep into his mind, uncatalogued, without citation. He finds it very difficult to retrieve the reference to any single bit of knowledge. If we ask him about the effect of social research on his decisions, he usually will not be able to give an accurate account – or even be aware that he derived his ideas from the social sciences. (Weiss, 1977: 534)

From interviews with the Director of the CSHE and officials from the DoE, it seems that, since 1999; there has been a breakdown in the relationship between the CSHE and the

¹² This is the forum of presidents of Science Councils as well Chief Executives of statutory bodies (e.g. CHE) and other national stakeholder structures such as SAUVCA.

Department of Education. Although it was difficult for the interviewer to come to grips with the source of the tensions between the CSHE and the DoE, the extent of the breakdown in the relationship is revealed in the following comment from a senior official in DoE:

I don't think the [CSHE] has engaged with the Department, not at all. I'm not aware of the [CSHE] coming to the Higher Education branch of the Department to say: "We want to come and talk to you about what we're doing, what the Department has been doing, and whether there's any basis for engagement or support." I don't think they've even attempted to engage us, so that they can say: "No, the department doesn't want to give us work." I don't think they have come to us for anything (from interview, 3 December 2003)

Although the breakdown in the relationship between the CSHE and the Department of Education is to be regretted since it diminishes the potential role that the former may have made in current policy development processes, it does not follow that a good relationship between the them would have increased the chances of utilisation of the CSHE's research in policymaking. The literature on knowledge utilisation has shown that increasing the communication or interactions between researchers and policymakers does not necessarily improve the utility of research:

[] it does not follow from our data, however, that an alliance of social scientists and policy makers is the panacea which will produce relevant research and allow translation of the results of scholarly analysis into terms of practical politics. The notion that more and better contact may result in improved understanding and greater utilization may be true, but there are also conditions where familiarity might well breed contempt rather than admiration. Caplan (1979: 461)

5 Conclusion

One of the key issues that have emerged from our discussion above is the multifarious understanding of the way in which the research undertaken by the CSHE was going to be utilised. The three notions of 'use' that were highlighted - which are also embedded in the objectives of the CSHE as set out in its constitution – are the following:

- ◀ Utilisation as generation of ideas, and particularly as a contribution to the debates on social reconstruction
- ◀ Utilisation as input into the policymaking process
- ◀ Utilisation as contribution to scholarship

With regard to the first usage, our analysis showed that the CSHE's research - even in the context of a demand overload coupled with poor response capabilities (Clark, 1998) - managed to fulfil this notion of 'use', especially in the period where policy development was in its infancy, and was dominated largely by debates at the level of ideas. In this regard, the CSHE's contributions to the deliberations in NEPI and the NCHE were singularly significant. This was however not a straight-forward role for the CSHE to assume, for, even though it was aware of - and even advocated - the transformative potential of knowledge production in social reconstruction, it was ill-disposed to assuming a 'hand-

maidenly' relationship to the democratic movement, and was resolute in maintaining its intellectual independence.

Regarding the second understanding of 'use', our discussion highlighted the diminishing role that the CSHE played in the policymaking arena after 1999, a period that has been referred to as one of delivery or implementation. The overall assessment of the CSHE's research contribution to policymaking in this period – especially from the officials of the Department of Education - was not favourable. Notwithstanding this assessment, it was also apparent that there were different understandings of the relationship between research and policymaking among the officials themselves; from some, there emerged an instrumentalist view of the relationship between research and policymaking, whilst from others there was a somewhat more nuanced understanding of this relationship - indeed, even a recognition of the enlightenment function of research. With regard to the third understand of 'use', the evidence is again unfavourable. It was shown that the CSHE has struggled to translate its research output into articles published in refereed journals.

A key limitation of this study has been our inability to delve into the details of the two projects that the CSHE undertook for the Department of Education. As we mentioned in the introduction, the current Director informed us that he would not be able to discuss the details of these projects, because of the strained relationship that continues to exist between the CSHE and the DoE, which is a consequence of some disagreements arising from these projects.

Another important issue that this study did not address is the apparent dichotomy between intellectual/scholarly and reconstructive/policy work – between the development and consolidation of the intellectual/disciplinary foundations of higher education studies on the one hand, and a focus on the 'development/policy periphery', on the other hand. It would be important, in trying to grapple with this apparent dilemma, to study other areas of scholarly activity such as health and science policy and see how, and to what extent, research centres in these fields have managed to balance this tension. The author would argue that it is premature to pronounce the divide between reconstructive and intellectual scholarship as unbridgeable on the basis of the CSHE's experience. The case study of the CSHE is important insofar as it helps the reader come to grips with the intractability of this tension. What was learnt in this study is the difficulty of trying to address these challenges simultaneously. The CSHE found itself in the unfortunate position of being torn between two imperatives that were not only (politically) exigent, but were equally urgent.

In the context of the declining availability of funding for scholarship of discovery (in its pure form, if there can be such a thing), research units like the CSHE have no choice but to undertake reconstructive work. Those that seem to have succeeded in holding these two imperatives in balance – like the Centre for Higher Education Policy Studies in the Netherlands – seem to have done so for two reasons: firstly, they operated under stable funding environments, having secured long-term support from their governments. Secondly, they had a core – albeit small - group of researchers who were beginning to establish themselves academically as the field itself was gaining prominence as an area of serious scholarship in Europe.

However, even in the context of the CHEPS experience, it seems that these needs – of meeting the demands of intellectual and reconstructive/policy work – were not met concurrently, but came to be balanced over time. It also seems – if one were forced to prioritise – that the primary requirement is to master the discipline of intellectual work before venturing into reconstructive work. It seems almost impossible to accomplish this balance the other way round, as it is difficult to develop the discipline of intellectual productivity once you are sucked into the cycle of dependency (for funding) that reconstructive work seems to inculcate. Alternatively - and that is, if you believe that it is the exception rather than the rule for any one person to be skilled in both scholarly endeavours – the solution is to be found in (research centres) having different people developing the expertise and capacity in these areas.

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CASE STUDY 14

THE ROLE OF ARGUMENTATION AND ARTICULATION IN THE DEVELOPMENT OF LEARNERS' CONCEPTIONS OF FRACTIONS:

Theories and practices of and for Mathematics teaching and learning

A research project of the Research Unit for Mathematics Education at the University of Stellenbosch (RUMEUS)

by Jaamiah Galant



Children receiving mathematics education. Photograph courtesy of Ms A Le Roux

CONTENTS

Abbreviations	592
1 Introduction	593
2 Research Unit for Mathematics Education at the University of Stellenbosch (RUMEUS)	594
2.1 Organisational history and context	594
2.2 Research agenda	595
3 Overview of research project	596
3.1 Project history and brief description	596
3.2 Project objectives and theoretical approach	598
3.3 Site and subjects of research	599
3.4 Data collection procedures	602
3.5 Project outcomes and outputs	603
4 Mode of knowledge production	604
4.1 The research process	604
4.2 Nature of research outcomes	609
4.3 Working as a research team	611
4.4 Shortcomings of the research	614
4.5 Dissemination strategies	614
5 Mode of knowledge utilisation	615
5.1 Researchers' thoughts on utilisation	615
5.2 Nature of utilisation	617
6 Conclusion	627
Data sources	629
Face-to face interviews	629
Observations of Third year B.Ed Lectures	629
Questionnaire	629
Project documents and publications	629
Further references	630

Abbreviations

AMESA	Association for Mathematics Educators in South Africa
B.Ed	Bachelor of Education
MALATI	Mathematics Learning and Teaching Initiative
M.Ed	Masters in Education
RUMEUS	Research Unit for Mathematics Education of the University of Stellenbosch
TAP	Together and Apart

1 Introduction

The heralding of dramatic political change in South Africa in the early 1990s saw a flurry of policy reviews and shifts from many state departments that were meant to be indicative of their willingness to embrace change and contribute to building a new society. In education, this period saw the merging of racially divided education departments into one national department of education, and the start of a decade of intensive school curriculum policy changes. Curriculum changes included both content changes (what contents were to be included and excluded), as well as pedagogic changes (approaches to teaching and learning). The new curriculum policies were often highly contested and posed enormous challenges, not only to the curriculum developers, but also to the practitioners (teachers, teacher educators, textbook writers) who were meant to interpret and implement these policies, and the education researchers whose work either informed the curriculum and classroom practice or offered serious critiques of the curriculum.

With respect to mathematics education, the dominance of progressivism and socio-constructivism¹ in mathematics education in the United Kingdom and North America, strongly influenced the mathematics curriculum changes in the late 80s and early 90s in South Africa, and remained implicit in subsequent curriculum changes². The main thrust of this influence was around pedagogic practices, which spawned a host of differently named ‘approaches’ in the field to the teaching and learning of mathematics. For example, we had the ‘constructivist approach’, the ‘new maths’, the ‘investigative approach’, the ‘problem-centred approach’ and approaches which were generally categorised as ‘learner-centred’ (Davis, 1995:23). All of these approaches advocated a shift away from direct authoritarian modes of teaching to a more facilitative mode of teaching, where learners were given opportunities to ‘negotiate’ meanings for themselves and ‘discover’ new knowledge on their own. As facilitator, the teacher’s role was to listen to and encourage learners to make their own meanings of mathematics and to produce their own solution procedures rather than impose any prescribed solution. There was a concerted effort within these teaching approaches to “embed mathematical contents in tasks that referenced the everyday or contexts that were familiar to learners” (Davis, 1995:27). Solving contextual word problems (sometimes called problem-solving), thus assumed a central position within these new modes of teaching. With their strong emphasis on ‘communication’ and ‘dialogue’ between learners, and between learners and teachers, these teaching approaches encouraged group work and classroom discussions.

Within the mathematics education research community in South Africa, it is widely acknowledged that the influence of socio-constructivism on South African mathematics curricula can be ascribed largely to the work of researchers at the Research Unit for Mathematics Education University of Stellenbosch (RUMEUS)³. From the time of its establishment in the early 80s this Unit undertook research, wrote textbooks and conducted teacher education workshops and courses to advocate and promote a ‘problem-centred approach’ to the teaching and learning of mathematics. Their research

¹ Understood very simply to mean “a theory about how we construct our knowledge as active participants rather than receive knowledge as passive recipients” (Volmink, 1993:33).

² For a discussion on the influences of ‘constructivism’ on mathematics curricula see Adler (1992); Laridon (1993) and Volmink (1993).

³ See Parker (1995); Davis (1995) and Galant (1997).

contributed to ongoing debates, discourses and insights into best practices in the teaching and learning of mathematics.

This case study report documents the initiation, process, outcomes and utilisation of one of the research projects undertaken by RUMEUS. The project formed part of the ongoing research within RUMEUS into the problem-centred learning approach to teaching mathematics. In particular, the project sought to gain a deeper understanding of firstly, how children, within a 'problem-centred' context, argue and articulate their thoughts when working in groups and, secondly, how these arguments reflect the way children learn mathematics. The mathematical context of the project is the teaching and learning of fractions. The project entailed extended classroom observations and included materials development, interactions with learners and teachers, as well as classroom interventions by both researchers and teachers. The research has been used extensively by the researchers themselves on the teacher pre-service and in-service courses at Stellenbosch University.

In this case study report we start with a descriptive picture of the broader organisational context within which the project is located, and of the project itself. We then step back from these basic descriptions and consider the way in which the knowledge is produced, transferred and taken up.

2 Research Unit for Mathematics Education at the University of Stellenbosch (RUMEUS)

2.1 Organisational history and context

RUMEUS was originally established in 1983 as one of a number of research units in social sciences at South African universities that were supported on a long-term basis by the Centre for Science Development at the Human Sciences Research Council. This ended in 1997, after which RUMEUS became a research unit within the Department of Didactics, reporting to the Faculty of Education at Stellenbosch University, and responsible for soliciting its own funds. It has been funded since then through donations, research grants and funded contracts for teacher training interventions.

Its first Director was Prof P Human, a senior mathematics education lecturer in the Department of Didactics, who upon retirement became a research consultant to the unit. The current Director, who took over in 1997, Mr Alwyn Olivier, is also a senior mathematics education lecturer in the Department. According to the Director, RUMEUS has never had more than one full time researcher. "Research associates" and Faculty staff participate in research projects. Mrs Hanlie Murray, another senior mathematics education lecturer in the Department, has also contributed significantly to the work of RUMEUS. Many of the research associates are drawn from mathematics education postgraduate students in the Department of Didactics.

RUMEUS has an Advisory Board that includes the Dean of Education, the Head of Department of the Didactics as well as mathematics educators from the Education Departments at the University of the Western Cape and the University of Cape Town. The Advisory Board meets at least once per semester and participates in the planning and monitoring of the unit's research activities.

In 1997, Mr Olivier was seconded as the Director of the Mathematics Learning and Teaching Initiative (MALATI) Project. This three year project was a joint venture of mathematics educators at the Universities of Stellenbosch, Western Cape and Cape Town. It was commissioned in 1996 by the Open Society Foundation for South Africa to develop, pilot and spread alternative approaches and tools for teaching and learning mathematics and to develop materials as interpretations of Curriculum 2005⁴ for school mathematics. The MALATI project involved materials development as well as direct contact and working relationships with schools and mathematics teachers. All the researchers from RUMEUS and mathematics education lecturers in the Department of Didactics at Stellenbosch University, were involved in various ways in MALATI.

2.2 Research agenda

Researchers associated with RUMEUS have had a long history and tradition in South Africa of advocating a 'problem-centred' approach to the teaching and learning of mathematics. It is an approach that positions the teacher as a facilitator of learning and in which learners make meaning for themselves and take responsibility for their own learning. This approach is informed by, and is consistent with, socio-constructivist approaches to teaching and learning that gained prominence in the 1980s as a direct challenge to 'traditional teaching'. In a 1993 publication, RUMEUS researchers describe some salient characteristics of problem-centred learning classrooms as follows:

1. *Students are presented with problems that are meaningful and interesting to them, but which they cannot (emphasis original) solve with ease using routinised procedures or drilled responses.*
2. *The teacher does not demonstrate a solution method, nor does she steer any activity (e.g. questions or discussion) in a direction that she had previously conceived as desirable, yet she expects every (emphasis original) student to become involved with the problem and to attempt to solve it. Students' own invented methods are expected and encouraged.*
3. *It is expected of students to discuss, critique, explain, and when necessary, justify their interpretations and solutions.*
4. *The combination of characteristics 1 and 2 show why a problem-centred learning approach is incompatible with traditional transmission mathematics teaching.*

(Murray H, Olivier A & Human P, 1993: 74)

In addition to their research publications that reflect on this approach, RUMEUS researchers have also published a popular series of school mathematics textbooks designed around the problem-centred approach and many of them have been actively involved in school mathematics curriculum reform processes in South Africa since the 1980s.

From its inception, the primary goal of RUMEUS has been to enhance the quality of mathematics teaching through research into the teaching and learning of mathematics, the development of learning support materials, publications and in-service training of teachers. To this end it has undertaken many and varied, mostly small scale, research projects.

⁴ This is the name given to the new school curriculum implemented in South Africa from 1997.

Mr Olivier, the RUMEUS Director describes the “golden threads” that run through RUMEUS research projects as “the social interaction of learning, verbalisations and children’s thinking” (Alwyn Olivier, interview). These “golden threads” are embedded within the mathematics content focuses of the research projects. Examples of mathematics content focuses include the teaching and learning of fractions and the use of technology in the mathematics classrooms. Recently RUMEUS also participated in a research project on problem-centred learning which was done in collaboration with mathematics educators from the Hebrew University in Israel.

3 Overview of research project

3.1 Project history and brief description

The project under discussion here is *The role of argumentation and articulation in the development of learners’ conceptions of fractions*, which was started in January 2000. Funds for two years, for the category ‘research group’, were obtained from the Stellenbosch University Research Fund Committee⁵. Mr Olivier, RUMEUS Director, was designated as the project leader and a research team was listed that included Ms Amanda le Roux, the principal investigator, and Mrs Murray, a senior mathematics education lecturer in the Department of Didactics⁶. The funding proposal does not indicate a principal investigator, but both Ms Le Roux and Mr Olivier confirmed that Ms Le Roux was the principal investigator.

Although funding was obtained for only two years, the project was part of the ongoing research agenda within RUMEUS, and the theories and materials that emerged from this project continue to be tested, adapted and refined by the researchers.

The research project was jointly conceptualised by Mr Olivier, Ms Le Roux and Mrs Murray as a RUMEUS project. The central focus of the project was on the role of ‘argumentation and articulation’. This referred specifically to the forms of communication and interaction between learners. Mr Olivier gives some reasons for why the project was framed in this way:

So the need for this, focusing on the articulation on their side, grew from our wanting to, on the one hand apply our theory of social constructivism, and on the other hand, the need to understand how children really learn in groups, okay. So this articulation thing was really focussed at how children learn in groups through verbalisation. [] The claims of the superiority of group work was always just on statistical analysis of comparing children learning in groups with children learning something else, and nobody knows what is really happening. So if you take a look at the title of the project you can see that it was an effort to try to find out how they learn in that group. (Alwyn Olivier, interview)

⁵ R43 100 was granted for the two years.

⁶ The other team members listed are: Prof P G Human, research consultant, RUMEUS Ms H De Vries, M student, Department of Didactics; Dr. C Puhl, Centre for Education Development of the University of Stellenbosch.

The quotes below highlight that the decision to use the teaching and learning of fractions as the vehicle through which to study learners' communication patterns was partly opportunistic, and partly out of a real concern with the way fractions are traditionally taught and learnt:

The reasons for fractions is because I was on the fractions committee, the MALATI again, you know I was involved with the production of the material, myself and Hanlie [Murray], so it made sense, and because it is a problem area, you know it is something that the teachers have difficulty with normally. I was already involved with the teaching here of the students and I knew that that was a problem area, you know, it was something that they have difficulty with the teachers, and it is something that is very easily taught instrumentally... (Amanda Le Roux, interview)

The broad history of the thing is then basically, I must re-live it, first of all there was from MALATI, the work on fractions working in Erica Primary, working with individual teachers. Secondly there was the formal study of the development of fraction concepts [] There are two contexts. There is the MALATI, there is the project working there, and there is the interest of my, and our, research students, Masters students. (Alwyn Olivier, interview)

Both Ms Le Roux and Mr Olivier acknowledge that using fractions as the context to investigate student interactions, was significantly influenced by the fact that, besides her involvement in the MALATI fractions working group, Mrs Murray had been investigating the teaching and learning of fractions for sometime already and had some ideas about the learning trajectory for fraction concepts and materials that would support this learning.

The research project entailed inserting fraction curriculum materials, based on the research work of the MALATI fractions working group, into classrooms and observing, over a series of lessons⁷, the way teachers and learners interacted with the materials and, in particular, recording (with video and audio equipment) what learners say and write. The set up of the project thus included giving the teacher a full package of curriculum materials on fractions and arranging that she teach from these materials twice a week for the whole year, during which time the researchers would come in to observe the lessons and hold discussions with the teacher. Occasionally, it included researchers themselves facilitating the materials and interacting with learners. Based on the classroom observations and discussions with the teacher, the materials were often also adapted or redesigned as the project unfolded.

It is through the MALATI work that the curriculum materials on fractions used in this research were first developed and a working relationship with Erica Primary school (the site for this research project) and its teachers was first established. This project thus built on an existing relationship with the school and teachers to gain access to the classrooms and learners. This was fortuitous, as Ms Le Roux comments:

[The teachers] were already familiar with most of the material because of MALATI, all of them were involved in the MALATI project. So they were

⁷ The principal investigator and a research assistant spent two mornings a week for the whole year observing these lessons.

familiar with our way of working they were familiar with the material and the problem-centred approach and that was another aspect, that we didn't have to do a lot of training, you know lot of workshopping with the teachers beforehand, we could start right away to collect data, because the teacher was already familiar with doing it in that way.
(Amanda Le Roux, interview)

In the next section we describe key project descriptors, including the project objectives, the site of research, data collection procedures and methodology and project outcomes and outputs.

3.2 Project objectives and theoretical approach

The problem statement and objectives are described as follows in the funding proposal:

The goal of the study is to find out more precisely how learners learn while they reflect on their mathematical thoughts and ideas. Our view is that well-designed tasks, good interpersonal relations and a culture of discussion and communication are essential pre-requisites for effective learning and we want to test this hypothesis through empirical study.

The more specific objectives of the research are:

- ◀ to investigate and describe the role of argumentation and the role of the articulation of mathematical ideas in the development of learners' conceptions of fractions;*
- ◀ to identify and describe the development of learners' conceptions of fractions as they formulate, test and justify their conceptions at various stages, and in addition*
- ◀ to identify and describe the facilitation strategies used by teachers in managing classroom activities in mathematics.*

(Funding Proposal to Sub-Committee A, January 2000: 2)

Underpinning these objectives is a broader theoretical perspective that adopts a socio-constructivist and problem-centred approach to teaching and learning mathematics. From this perspective, learning is seen as an individual as well as a social process and is optimised when learners have to solve meaningful mathematical problems in heterogeneous groups⁸. The funding proposal makes strong arguments for the establishment of a “problem-centred classroom culture” as a pre-condition for the research project. It argues that “in a problem-centred classroom culture where learners discuss, critique, explain and justify their interpretations and solutions children can learn more effectively from each other”. It explains that “a problem-centred learning approach to mathematics teaching is based on the acceptance that students construct their own knowledge and therefore this approach attempts to establish individual and social procedures to monitor and improve the nature and quality of those constructions”. The proposal goes on to state that the research “sets out to help teachers to create an inquiry classroom culture, help children to develop adequate communication skills, and then study

⁸ Translated from Progress Report to Sub-committee A 2000/2001:1.

how argumentation and articulation influence the development of their understanding of fractions” (Funding Proposal to Sub-Committee A, January 2000: 2).

From the above we see that while there is a clear line of inquiry embedded in the objectives of the research project, they are also geared towards some kind of intervention to create a particular ‘classroom culture’. This was echoed in the interviews with the project leader and the principal investigator:

We are not really interested in working in traditional classrooms, I don't work in traditional classrooms. Whatever, we know what are the results, we can go into any traditional classroom and show that children know nothing, learn nothing. [By this I mean] the teacher led, teacher-centred, he will mark the homework, show something, then children practice five of the same, and here's more homework. We try to change the classroom culture, social norms etc, and then we see what can happen in this new culture. So then, social interaction, etc, so in the broader sense, how does learning takes place in this classroom culture, then we can study how the children learn whatever, fractions, algebra, geometry, in a different context. (Alwyn Olivier, interview)

I think the whole idea of how do you structure your classroom became very clear to me, the kind of questions, the importance of the full class discussion, you know, there's certain things that are prerequisites and it won't work, and that is why I think a lot of people don't understand the problem, you know, working in a problem centred way. [] Children have to, they have to be willing to explain themselves, and that is the most difficult one to get. So they have to be willing to explain, they have to listen to one another and then the way in which [], the teacher handles mistakes, you know, that the children understand it's not the end of the world if you make a mistake, you know we all make mistakes, so the way in which the teacher handles mistakes is very important. The fact that everybody's ideas are valued and that comes out in the full class discussion, [], I think that is very important because, when that takes place then [the teacher] would show to the class that she values every idea. (Amanda Le Roux, interview)

Drawing on the work of Paul Cobb *et al* (1992), the principal investigator referred to these features of the ‘classroom culture’ as the “social norms” that learners and teachers have to acquire in the problem-centred classroom. In other words, the ‘social norms’ include the willingness to explain and justify answers, to listen to the explanations of others and not to be fearful of making mistakes.

In later sections we will consider how successfully these objectives were met over the duration of the project.

3.3 Site and subjects of research

Although selecting the school and teachers for this research project appeared quite opportunistic, as mentioned earlier, there were in fact very particular conditions that were sought for the site of research. Two of these for example, were the issues of language and school infrastructure. The original project funding proposal of 2000

mentions a primary school in Khayelitsha⁹ as the site for the research project and two intermediate phase¹⁰ teachers and their learners as the “subjects” of the research. But, as the principal investigator explains, this site was subsequently changed to a school where the first language of the learners was English and the school was perceived to have a more stable infrastructure:

In the school in Khayelitsha, because I couldn't understand the children, I didn't actually know, you know what was going on in the groups, I could see they got excited, I could see that they were involved, but I couldn't really follow what the kids were saying. [] And then Alwyn suggested, you know I wanted to go to Khayelitsha, and then we thought the language problem, there is so many hiccups doing research there, you know, they don't always have the infrastructure. Okay, I won't talk about all those hiccups, but we just thought it would be easier [at Erica Primary].
(Amanda Le Roux, interview)

According to Ms Le Roux, the project school, Erica Primary, was initially proposed by another colleague in the academic support division at Stellenbosch University, who was also on that school's governing body, and he wanted to involve RUMEUS in a 'whole school project' at Erica Primary, that would focus on school governance issues as well as curriculum issues. However, this big project never came off, but RUMEUS researchers decided to continue to pursue the possibility of using the school for its project, since some of the teachers already had experience with using MALATI materials.

Once Erica Primary was identified as the potential project school, they approached the principal to ask for permission and then called for teachers from the intermediate phase to volunteer as subjects. This process seemed to work fine:

That was the one thing about the project, we had the full support of the principal and we asked for volunteers first, who of the teachers were really interested and we decided we could sort of manage, I think we started with three teachers and it was difficult to do all three of them.
(Amanda Le Roux, interview)

Problems however arose once they started entering the classrooms. Some teachers were unable to create the necessary conditions in the classroom to conduct the research. As a result one of the initial teachers were dropped and the Grade 4 teacher from the first year was replaced by a Grade 6 teacher in the second year. While at least two teachers' classes were observed during both years of the project, only data from one teacher's classes (Ms B)¹¹ have been used in the final analysis and write up of the project. Below, the principal investigator describes some of the reasons why they could not continue with the other teachers:

So at the beginning we started with Ms B, Mr S and Mr H. Mr S I thought was very bright, but [] we couldn't rely on him, he was hardly ever in the classroom, but he was very bright. I was actually very sad about that. I think

⁹ This is a sub-economic suburb in the Western Cape Province. The first language of most learners and teachers, as well as the language of instruction, at this school is Xhosa.

¹⁰ This Phase comprises Grades 4, 5 and 6 of the General Education and Training Phase.

¹¹ She was the only teacher observed during both years.

he understood, and then he had these fits with the kids, dan skel hy hulle uit (trans: then he scolds them), you know, and he would, they were so scared, so you know, you can't really get data from them. So he was replaced with Ms R in the second year.

Mr H was very willing and he was the other grade 5 teacher, and he had to do the same things as Ms B was doing anyway, because they had to be in since, you know, and he was very sweet, but he also had this, and he was booked for psychological, ek weet nie watter probleem nie (trans: I don't know what problem), stress, stress related, but he also, he had a different view of discipline, you know he had a desk where the kids had to sit when they were naughty, and things like that, and he was tense, you know, he was very nervous, he was very nervous about the video camera in the class and things like that, so we in the end we didn't actually [use data from his class]. (Amanda Le Roux, interview)

Mr E has left teaching, [] I think he was a bit unhappy, he was a brilliant teacher, [] but his heart was never, he was always dissatisfied with the way things were going in teaching, you know []. He was always, hy's altyd a bietjie ontevrede gewees (trans: he was always a bit unhappy), and I didn't want to work with somebody who's not willing, because you have to have the co-operation, [so he was never actually part of the project]. (Amanda Le Roux, interview)

In contrast to the teachers described above, Ms B was seen to display the necessary qualities to get learners talking:

Ms B was very unsure, but [], I think, another thing that one really needs, if the teacher who is genuinely interested in the children, if a teacher is really interested in the development of the children, she will listen to the children, you know things like that almost come naturally, and I think in a way she grew in realising that she can, you know, she can organise, and she was so soft with the kids, you know, she was never, well she's also strict, but not like Mr S was, skel met die kinders en so aan (trans: scold the children and so on). (Amanda Le Roux, interview)

It is clear that there needed to be a guarantee of co-operation and a certain degree of compliance from the teachers to buy into the 'classroom culture', in order to collect data on learners talking to each other and verbalising their thoughts. Without this, the research aspects of the project would be undermined. In fact, the funding proposal explicitly describes the teacher 'subjects' of the research as "[teachers] who are familiar and comfortable with the curriculum material developed by the MALATI team and will be able to facilitate and manage learner interaction" (Funding Proposal to Sub-Committee A, January 2000:3).

From the above we see then, that while it was fortuitous that there was an existing relationship with Erica Primary and its teachers, selecting the school and the particular teachers to focus on was also based on sound research principles, namely, that the

conditions were optimal to collect data and that the data was in a language that could be understood and interpreted by the researcher.

3.4 Data collection procedures

Three forms of data and data collection procedures were used:

- ⤵ Participant classroom observations, where learner interaction and teacher facilitation was captured on video and audio tape and notes were taken by the observer. Where appropriate, learners were asked to elaborate on their practices (e.g. decisions made during the problem solving process)
- ⤵ Learners' written work was collected, and
- ⤵ Follow-up individual interviews with learners were conducted where necessary.

The participant classroom observations involved the principal investigator and a research assistant (who was a B.Ed student), going into classrooms two mornings a week¹². During these periods, typically, the teacher would present a problem, drawing on the fraction materials supplied by the researchers, and learners would engage with the problem collaboratively in groups. Once groups have reached consensus on a solution, the teacher would facilitate a whole class discussion during which solutions and ideas would be shared in the classroom. As one of the teachers, Ms B was always expected to organise the classroom and present the lessons, while the researchers were expected to be observers of the lessons. However, as the principal investigator points out, the researchers were also very often active participants in the classroom:

I made it clear that I will try not to upset their normal way of doing things, I will try to give them support but, you know, I want to observe mainly and give them the material, but it didn't work out in that way. I did a lot of teaching myself, you know, co-teaching with Ms B, talking to her all the time, but we didn't interfere with the way she grouped the kids at the beginning. (Amanda Le Roux, interview)

Ms B always presented the problem, I didn't want the children to think that I was the teacher, you know. [] She would present the problem, and then we would just sort of facilitate, and then sometimes I would take the feedback sessions to almost demonstrate to [the teacher], and sometimes [the research assistant] would do the feedback, and sometimes, towards the end, [Ms B] did almost all by herself, most of the times, we were just doing the observations, [data capturing]. [The research assistant] was normally handling the camera and then we had a tripod, and sometimes she would put it up with one group and then she would go to a group and I would go to a group, to get as much data as possible. (Amanda Le Roux, interview)

Where researchers did interact directly with learners, this too was captured on video and audio tapes. While the primary focus for data collection was on learner-learner interactions and verbalisations, a secondary focus was on the facilitation strategies of the

¹² In 2000, one Grade 4 and two Grade 5 classes were observed and in 2001, one Grade 5 and one Grade 6 class was observed (Progress Report to Sub-Committee A, 2000/2001: 1). Ms B taught Grade 5 and most of the data reported on were obtained in her classes.

teacher and learner-teacher interactions. As such, both the teacher and learners were clearly the subjects of the research, although the participation of the researchers also contributed to the outcomes of the research.

Video and audio material, as well as the interviews were transcribed and then analysed together with learners' written work.

3.5 Project outcomes and outputs

Project outcomes

At least six expected outcomes are listed in the project funding proposal. These outcomes are all descriptions that relate to learners, teachers and learning materials:

Learners:

◀ *Description of conditions for constructive interaction and argumentation in the mathematics classroom (features of a classroom culture that will facilitate the processes).*

◀ *Description of ways in which learners resolve arguments that may lead to the production of taken-as-shared knowledge.*

◀ *Description of the cognitive processes in the development of learners' conceptions of fractions.*

◀ *Description of possible variety of ways in which learners articulate their mathematical ideas.*

◀ Teachers:

◀ *Description of facilitating strategies for teachers to elicit and manage argumentation and articulation.*

◀ Learning material:

◀ *Description of characteristics of learning material (activities) that elicit argumentation between learners.*

(Funding Proposal to Sub-Committee A, January 2000:4).

We see that these outcomes are all products that ought to emerge from the classroom observations. Embedded within these outcomes we see a particular model of teaching that privileges learner talk in the classroom. The model encompasses a classroom culture in which learners are encouraged to interact with each other and to articulate their thoughts on the mathematics and their own learning, and teachers are encouraged to facilitate and manage this learning. The outcomes assume that through this mode of teaching and learning, one will gain a deeper understanding of the cognitive processes in the development of mathematical concepts for learners, in this case it happens to be understanding of fractions.

Reading and interpreting the outcomes, it is not surprising that the value of this research is measured primarily by its contribution to "teaching practice by identifying those features in classrooms that really make successful teaching and learning possible" (Funding Proposal to Sub-Committee A, January 2000:4), and to "the local and international research community's knowledge with respect to the processes by which learners master fractions as well as, general theories about learning mathematics"

(Translated from Progress Report to Sub-Committee A, 2000/2001:8). In other words, the outcomes of this research are geared towards new knowledge and improved practices within the field of mathematics education.

Project outputs

Since 2000, at least three articles have been published in mathematics education journals relating to this research (one of these in an accredited journal), four papers presented at international mathematics education conferences, four papers/workshops presented at the annual national mathematics education conference in South Africa, and one lecture at the Hebrew University of Jerusalem. All of the papers relate in various ways to learners' mathematical reasoning, learner-learner interactions, conceptual development of fractions and problem-centred learning. Most of these papers have been co-authored by members of the research team as well as research associates to RUMEUS and MALATI. In a later section we will examine more closely the dynamics of the research team and the production of the co-authored papers.

4 Mode of knowledge production

In this section we describe in more detail the process and outcomes of research and knowledge production. This includes descriptions of the nature of the research process and research outcomes, interactions with the research subjects, the research team dynamics, and shortcomings of the research.

4.1 The research process

While the research objectives were clearly articulated in the project proposal, the research plan and design seemed to be much more hazy. The quotes below suggest that the researchers had some ideas of what they were looking for, what they would focus on and had implicit theories of learning, but they did not really have a strong plan or research design going into the classrooms:

I had quite an open mind about that and I wasn't sure what I was going to get. [] I hoped that I would be able to get examples of children sitting together and talking. Because I wanted to analyse it. I wanted to find out in what ways do they communicate, are they able to communicate about the mathematics, without clear instruction, you know, simply working on a problem, what are they like when they do that. How do they handle that, how do they clarify the problem, how do they decide what strategies to use. (Amanda Le Roux, interview)

In this kind of research, [] your objectives are not always clear, it evolves as you go along, and I think that is what happened, I almost went in there and tried to see what do I get, and from there it almost crystallised, you know, the things which you get and you, and you realise that that is what I was actually looking for, but I didn't verbalise it in that way. (Amanda Le Roux, interview)

We used the so-called 'grounded theory' theory, where which as you would know, is quite open. In other words it didn't have preconceived ideas, but built the thing as we went on. [] We study the learning through

articulation, but we do it in the context of fractions, that means that we are gathering information, two kinds of information. One is social processes, how they learn through the social processes, which on the one hand can inform theory of learning, but on the other hand, feedback of what they are learning about fractions, and therefore, we supply the materials, so we used that as feedback to spell out this learning trajectory, is very important. (Alwyn Olivier, interview)

The researchers, through unstructured observations, thus gathered data on the social interactions and nature of communication in the classroom as they happened, as well as data on the cognitive aspects of learning fraction concepts reflected in the dialogue and writing of learners. The research process can be characterised as quite open and flexible in the sense that, as the process went along the researchers, as participant observers, adjusted and refined what they did and what they focused on. This pertained particularly for example, to the organisation of learners into groups as we will see below.

Following the underlying principles of problem-centred learning described earlier, simply organising learners into groups without thought was not good enough. In the first place, learners had to be given problems that forced them to think about the mathematics and to articulate their thoughts on how to solve the problems. The purpose then of solving these problems in groups was to enable learners to talk to each other and to learn from each other. Within this context, the researchers viewed ‘groupwork’ as “a monitoring procedure and a formative or diagnostic assessment tool” (Le Roux A, Olivier A & Murray H, 2004:90). In other words, the oral and written interactions that occurred between learners in these groups were used as “diagnostic evidence of learners’ present understanding.” (ibid). They were thus used to plan further teaching and design appropriate materials. As such, considered thought had to be given to how groups would be made up. Here, the researchers had a theory or teaching model of ‘Together and Apart (TAP)’ that determined how groups were to be constituted. This theory seemed to be implicit in the research design. The project leader clearly endorses and explains the theory:

TAP assumes diversity in the classroom, but it believes that the way to, on the one hand if you like, cope with diversity, and on the other hand, to celebrate diversity, to use it, is the broader context of communication, namely that everybody has a contribution to make. In other words, for me the project must take place within heterogeneous groups. [] Assuming everybody can learn mathematics, okay, make it different abilities, but then the view is that we learn in heterogeneous groups because that way we, so its distributed knowledge, we build on each other, [and] there is a fine print in this teaching model, TAP, [which] was [that] continuous testing would identify what kinds of problems different children have, and then for a short while you make homogeneous groups that are different, then you address their specific problems. Homogeneous, not on ability, homogeneous on understanding some specific concept or whatever. [] You’ll [then] address their problem, and then you sort of solve it, and then you go back to heterogeneous groups. (Alwyn Olivier, interview)

According to this theory then, groups were primarily to be organised into heterogeneous groups and when necessary, put into homogenous groups to address specific problems of the group. Ms Le Roux seemed more ambivalent about this theory, and describes it as a source of difficulty in the research process. She admits that initially, they did not implement the theory, primarily because she saw her main role as that of observer, and did not want to be prescriptive about what should happen in the classroom:

The group functioning, that is something that was not specifically mentioned, but it's also a part of the classroom culture thing, because there is the whole, and I still don't have clarity on that, which groups would function best. Alwyn and Liora [a RUMEUS associate], their big thing is heterogeneous groups, and at the beginning, now I was very, I was so grateful for the school taking us, so I didn't want to impose a whole lot of things on them and I made it clear that I will try not to upset their normal way of doing things. [] [So] we didn't interfere with the way [the teacher] grouped the kids at the beginning, although I think they were heterogeneous groups. (Amanda Le Roux, interview)

At some point, towards the middle of the year, they did however intervene in the organisation of the groups. Again, she expressed some ambivalence about the value of heterogeneous groups:

Towards the end of June, we did our first assessment, you know, almost like a little test where the children have to do individual, you know, where they don't work in groups, and it was total chaos, you know, with a whole lot of the groups, some children couldn't do a darn thing, and I thought it was because some of the groups were too heterogeneous, you know, you've got these kids working very fast and these working very slow, and the slow ones just couldn't get on, so we tried to implement Liora's model of TAP, [] we analysed the tests and put the kids that [struggled with] some concepts [], you know we put them together and work with them separately. (Amanda Le Roux interview)

Implementing 'TAP' meant changing the groups all the time, and this presented another set of problems when there were clashes of personalities:

But the groups were changing all the time, you know, sometimes one group wouldn't function. Sometimes [because of] personalities. I think that is the most important thing, is personality, not necessarily the academic level, because you can get fast children working well with slow children, and you get some fast children [] that are so bitchy [] that [] it just doesn't work, they fight all the time. (Amanda Le Roux, interview)

Ms Le Roux describes much more positively, her experience of observing two 'weak' learners who she had encouraged to work together, even though this was contrary to the idea of working in heterogeneous groups:

I took the two of them out, and for a few weeks I sat only with the two of them, because both of them were very, very weak, and I thought [], I'm going to try to see if these two weak kids, if they are able [to succeed], and that was quite rewarding, [], because it appeared in the end that YYY wasn't so, she wasn't so slow, she was actually, she had very good ideas, but

she was just, she didn't have the confidence to express them, and with XXX there, and she had to explain to XXX, so that was a very good experience too. (Amanda Le Roux, interview)

It appears then, that despite the idea of heterogeneous groups being implicit in the research design, in the research process Ms Le Roux worked quite flexibly with implementing this idea, using her own assessment of what was appropriate at a particular time. We will see later that this was in fact a source of tension within the research team.

We saw earlier¹³, as participant observers, the researchers sometimes co-taught the lessons, facilitated the groups as well as the whole class discussions. In addition, they frequently adapted the learning materials as they went along, based on how learners responded to the existing material:

We designed extra material, you know when you see something with, as I did with the teacher in the class, [], when I said this problem didn't really work, [] we changed, or we made extra material, [which we would use instead]. (Amanda Le Roux, interview)

What we were really doing is to get information to test all the time, to see how children are learning from the materials and from their interaction. And if the materials was not doing their job then we had to adapt the materials, and that we did [in our weekly meetings]. (Alwyn Olivier, interview)

Reimers and McGinn (1997), propose the following categories to describe research, based on the research aims, objectives and processes:

- ◀ Academic research (explaining theories, models, frameworks)
- ◀ Planning research (finding factors to produce desired outcome)
- ◀ Instrumentation research (constructing or organising factors to produce desired outcome), and
- ◀ Action research (investigating whether a desired outcome can be produced).

Using Reimers and McGinn, we can argue that this research project entailed a combination of all these categories of research. On the one hand, it can be described as **academic research**, since the research sets out to demonstrate how a model of 'problem-centred' teaching and learning should work in terms of organising learners into heterogeneous groups and the kinds of questions and assessment that should take place in these groups. On the other hand, it can also be described as **planning and instrumentation research**, since, throughout the research process, researchers were experimenting with different strategies in the classroom to get children thinking and talking and adapting the materials along the way. In other words, the researchers were conducting field experiments in which they were constantly trying to find, construct or organise factors to produce the desired outcome, which in this case was to get learners to understand fraction concepts through argumentation and articulation. Finally, we can even describe

¹³ See quotes under 3.4 "Data collection procedures" on page 17.

the research as *action research*¹⁴, if we consider that the researchers went into the classrooms with the intention of observing learners and teachers interacting with each other and the materials, and not knowing for sure whether the desired outcome could be produced, that is, whether learners could reach understanding of fraction concepts through argumentation and articulation.

It is clear that the research project was driven primarily by the intellectual concerns of the researchers for new knowledge on how children learn and talk about mathematics, on the types of problems learners should be given to stimulate their thinking and get them talking or arguing, and on strategies teachers could use to manage and facilitate learning. Insofar as this new knowledge could have practical applications in the classroom, the research can also be categorised as *basic strategic research*, following the Frascati categories¹⁵. The primary focus of the research was always the advancement of knowledge and the improvement of practice, in the field of mathematics education. To a lesser degree, the research also attempted to influence curriculum policy. Mr Olivier referred for example, to written comments he had sent to the Western Cape Education Department, responding to what he perceived as 'skewed perceptions' of what child-centred meant in the new curriculum statements:

I did at some stage send a comment to the education department, which I feel was informed by this, we were trying to show, [that] the idea of 'child-centred does not mean teacher-centred' is ridiculous. We are not teacher-centred, but we remain absolutely content-centred, in other words, as long as we put the content in front of the children, it is exactly the same, the structure of the content is logical, then it doesn't matter if you're working in groups or teaching or whatever. The real villain is the content, not whether it is teacher led or not. (Alwyn Olivier, interview)

We will see in Section 4.2 how the nature of the research outcomes reflects the driving forces and focus of the research process.

The teacher as research collaborator

In the project funding proposal the teacher is described as one of the 'subjects' of the research. However, it is also true that the interactions with the teacher forms a crucial part of the research process. The principal investigator refers to regular "little workshops" they held with the teacher as well as constant conversations in the classroom:

We had little workshops, just sort of informal workshops in the afternoon where we would talk about what was happening in the classrooms, what were their questions, what we thought was good what we thought was not good, and then of course in the classroom we were talking all the time, we were making sure that they understood the material, the purpose of the material, the objectives [of the problem], what we were trying to achieve with that problem. (Amanda Le Roux, interview)

¹⁴ Here I am again following Reimers and McGinn's definition, which does not concur exactly with other understandings of action research as 'reflection on practice'.

¹⁵ The other Frascati categories are basic and applied research.

Very often when I sat with a group and something happened, I would get up and I would share that with the class, or I would call Ms B, Ms B see this is what happens. (Amanda Le Roux, interview)

Bearing in mind that the teacher was always present and she was encouraged to present the mathematical problems to learners, the teacher's input also had to have some influence on the research outcomes. This was acknowledged to some extent by the fact that the teacher was asked to give a written contribution to one of the progress reports, the principal investigator discussed the research papers with her and she is acknowledged as a co-author of a short paper done at the South African national mathematics education (AMESA) conference in 2000. The principal investigator and project leader describe the teacher's involvement in some of these things:

There were continuous interaction with the teacher, before and after lessons, and everything we wrote, short papers, long papers etc, would go, you know, the teacher did not participate as an active author, but we always gave her the papers to read before. (Alwyn Olivier, interview)

What I did was I wrote a little thing and I sent it to Therine¹⁶, and Therine went to Ms B, they discussed it and Ms B said what her ideas was, so ya, she's acknowledged as a co-author of this [paper]. (Amanda Le Roux, interview)

I would argue that the characterisation of the "teacher as the subject" of the research is misleading. The teacher within this research project acts more as a research collaborator, in the sense that she contributes to setting up the conditions for the collection of data. That is, the teacher is jointly responsible for creating the 'classroom culture' in which learners are encouraged to argue and articulate their thoughts about the mathematics. By facilitating many of the classroom discussions¹⁷, the teacher through her questions, directs the nature of learners' discourse. The research outcomes related to facilitating strategies for teachers are produced by the actions of both the researchers and the teacher.

Capacity building

It is difficult to say whether there was a concerted effort at research capacity building in this project. Nonetheless, the B.Ed student who was the research assistant continued with her M.Ed, except that she changed subjects and moved to Environmental education. At the end of the funding cycle for this project another mathematics M.Ed student continued to collect data in the project classroom for her dissertation. No other research students or novice researchers were involved in the project.

4.2 Nature of research outcomes

The research outcomes fall into two broad categories as described by the project leader:

On the one hand it is testing and developing our socio-constructivist theory and on the other hand developing a curriculum for the learning of fractions. (Alwyn Olivier, interview)

¹⁶ This was another M.Ed student who used some of the data for her study.

¹⁷ See second quote under Section 3.4 "Data collection procedures".

The outcomes that relate to testing and developing socio-constructivist theory are those that refer to the classroom culture, the social interaction of learners and their forms of discourse, and the role of the teacher.

From the descriptions by Ms Le Roux and Mr Olivier, we see that these research outcomes are essentially new insights into a particular theory of teaching and learning:

Everything about the classroom culture was very vague and cloudy and woolly and I was able through this project to almost distil things which I think is important. [] I think the whole idea of how do you structure your classroom became very clear to me, the kind of questions, the importance of the full class discussion. (Amanda Le Roux, interview)

We were looking for a theory, choosing amongst theories that we would use to analyse it and describe the social, the verbalisation, the interaction in the group. And so there are several theories and, you see, we were pushing for a certain, [] a description of different kinds of discourse. (Alwyn Olivier, interview)

I'm sure, we developed, I said before, developed, illustrated our theory, for sure. [] We made major strides there, as I said just now, when I worked on the conclusions there, there were three, four places where, very explicit, I think those descriptions of the analysis illustrated various aspects of our theory, it's written, very happy with it. And I think simultaneously we developed, as I said, a fractions curriculum, not the right word, the materials for the curriculum. (Alwyn Olivier, interview)

The analysis and description of learners' forms of discourse are elaborated in great detail under research outcomes in the two progress reports submitted to the university research committee. In these reports they use transcripts of learner-learner interactions to illustrate for example, what they call "cumulative and exploratory conversations" and "constructive interactions" between learners. They also describe factors that inhibit "constructive interactions" and factors that contribute to the development of learners' fraction concepts, again using examples from the classroom.

Learners' forms of discourse are also analysed in great depth in several of the papers published on this research. In one of the papers, it appeared that the researchers had reached consensus on a particular theoretical tool, namely, Toulmin's scheme for the analysis of argumentation, to interpret different stages of learners' discourse. This scheme is described as follows in the paper:

Toulmin describes four parts in an argument – a claim, data, a warrant, and a backing. A speaker makes a statement that s/he claims to be certain (for instance a suggestion made by a student towards finding a solution for a problem). This is the claim of the argument and the claim has to be supported by more information or evidence explaining why it should be considered as true. The additional supportive information is the data of the argumentation, while the warrant explains why the data should be accepted as support for the claim. Further support for the warrant is provided in the

form of a backing. The backing refers to global convictions and primary strategies and binds the core of an argument to collectively accepted basic assumptions. (Le Roux, A., Olivier, A. and Murray, H., *Children struggling to make sense of fractions: an analysis of children's argumentation*, *South African Journal of Education*, Vol 24, (No 1) February 2004:90).

Mr Olivier explains the value of Toulmin's scheme:

Toulmin, [] in a sense brings value because discourse, the science community has a certain discourse of how to convince somebody else, it is supposed to be logical reasoning, that logical reasoning we can analyse. So Toulmin is very nice, we've studied him, the 'warrant' and the 'this and that', and it's very useful for us, we also, I try to incorporate even in my courses, if I can convince my students to look at everything in terms of this, looking for a 'warrant', and a 'backing', in order to judge, and the 'validity' of any statement, then we've come a long way. [] I think something like this Toulmin's theory is, I actually think that all students should be, should pass such a basic little course in logical reasoning, with something like Toulmin behind it. (Alwyn Olivier, Interview)

From all of the above we can see that the research outcomes have at the very least contributed to the advancement of the researchers' own knowledge of teaching and learning mathematics. The nature of research outcomes can best be described as *epistemic outcomes*. That is, they provide new insights into the way children talk and construct arguments in mathematics, they suggest a particular model of teaching that is problem-centred and encourages learner-learner interactions, they hypothesise about the cognitive development of fraction concepts for learners, and they provide new insights into the construction of fraction learning materials. Although the outcomes do not actually propose a new theory of teaching and learning, they do advance the use and interpretations of existing theories, which the researchers package into a model of 'best practice' for teaching and learning mathematics. We look more closely at this in Section 5.2. where we discuss researchers as 'users' of the research.

4.3 Working as a research team

Ms Amanda Le Roux was the principal investigator and Ms Heleen De Vries, a Masters in Education (M.Ed) student, was the research assistant. Together they did all the field work, that is, they did all the classroom observations. Ms Le Roux has been working as a researcher within RUMEUS since 1997. Mr Alwyn Olivier, Director of RUMEUS was the project leader. He has been a senior lecturer in the Department of Didactics for 21 years and has a long history of research and publications. He describes his role, quite reluctantly, as follows:

You must ask other people what my role was. Consultation if you like, but I would say, those first two years, I would rather say it was just, on the other hand we tried to have this whole group of people involved, so I was just part of the group. (Alwyn Olivier, interview)

Well, my approach as project leader if you want, is that I try not to be autocratic and secondly, I don't actually believe I have this autocratic power or whatever, so I try to investigate the problem academically by trying to

build up a shared knowledge between us of articles we've read, for instance we've analysed etc, and then assume these become shared points of view. But I would say I at some stage tried to be authoritarian, and said, you MUST go back and you HAVE to make heterogeneous groups. (Alwyn Olivier, interview)

The other active member of the research team was Mrs Hanlie Murray. She has been a senior lecturer in the Department of Didactics for 26 years and also has a long history of research and publications relating to problem-centred teaching and learning and, in particular, children's understanding of fractions. As a research team, all four of them met once a week for two hours. The principal investigator describes the value of these meetings and the nature of support she received:

We had during those two years, we had weekly meetings, and then I would always report on what happened and I would ask questions, I would say I didn't know how to handle this, or this happened with this child, what do you think about that, and also about materials particularly, you know if I thought this problem didn't work, and what do you suggest, and if I designed a new problem I would show it to them and ask their ideas about that, I found that very helpful. (Amanda Le Roux, interview)

And then of course, Alwyn was the one who sent me with articles, and to read and stuff, that's one thing, because I simply don't have time to go on the internet, so whenever he sees something, you know, he would send it. (Amanda Le Roux, interview)

Besides the feedback and support received from these team meetings, Amanda also refers to the role the project leader played in keeping her focused on the research objectives:

"Want hy was baie streng met my altyd, hy het gesê ek doen nie wat my job is nie" (trans: he was always very strict with me. He said I wasn't doing what my job was). (Amanda Le Roux, interview)

I had to remind myself, and Alwyn always reminded me, remember you are not actually supporting the teacher, your job is to get data, data, data, that was hammered into me, that I must get hold of the data, and I must forget that I am supporting the teacher, because you know, that was secondary, but it just happened, so, that wasn't really the objective. (Amanda Le Roux, interview)

Ms Le Roux did not talk about any difficulties experienced working within this research team. However, Mr Olivier, as project leader, was much more critical about the team dynamics and their approach to the research project:

The preconceived ideas that researchers take into the project is always a big problem. In this specific case, it was an important context for us because we differ about certain fundamentals, and it was quite serious stuff actually. (Alwyn Olivier, interview)

One of the 'things' they differed on was the application of the TAP model, that is, organising learners in heterogeneous groups. Very often he felt that he was fighting battles on his own:

Now, when I said there was a problem [in the group], then it is that time after time after time, when I say tell me what is going on, I'm told, I was told but this and this and this, and they put them into homogeneous groups, and my colleagues have a theory that the weaker children do not cope in the groups etc. [] So, it was a conflict between ability grouping and heterogeneous grouping. And as far as I am concerned every time they put the children, put the children in ability groupings, it is just so stupid. (Alwyn Olivier, interview)

He also expressed some ambivalence with the way the team dealt with using theory to analyse the data:

I find that our group is not able to systematically put on the [theoretical] lenses, boof, and analyse it, it's always this and this, you know that's fine, but for certain time and stretch you put on this glasses and you analyse, and you say, this is the context, there is a cognitive context, there's a social context, there is this, I found that we had made heavy weather of really doing this, and I am not sure if I'm glad or disappointed in the end. (Alwyn Olivier, interview)

Despite these disagreements and tensions within the group, the research was still viewed as a team effort. This is reflected in the joint authorship of most of the research publications. From the description below we see that the team members made different kinds of contributions to these publications:

First of all, we worked a lot on identifying what is it we want to write, what do we have, putting all that on the table, but then Amanda was the main author, that's her job, she's the researcher in the unit, but then, in this specific case for example, we all would comment, Hanlie would comment, basically, the structure, grammatically if you like, while for example, at a very late stage it was pushed and left on me to try to address the theoretical issues, for example. I then wrote the theoretical introduction and I, took it quite seriously, I worked seriously on drawing the conclusions in the discussion part. (Alwyn Olivier, interview)

Within this research team it seems that Ms Le Roux gained enormously from the inputs and experience of the other two more senior researchers. They supported her throughout the project giving valuable feedback on the progress and actions to take within the research process, the analysis of data and the design of learning materials. While there may have been tensions and disagreements as the research progressed, they managed this by employing theoretical tools that they all endorsed and bringing their own voices to bear on the published outputs.

4.4 Shortcomings of the research

The shortcomings of the research as described by Mr Olivier relate mainly to what he perceives as the lack of rigour in the approach to the analysis and the slowness with which the research was written up:

If you are an academic you judge the research and the theory etc, you do not, on anecdotal and personal experience bring your preferences into the plan. So this kind of preferences of simple little incidences, of people's own children, for example, feeling uncomfortable in a clever group and rather would be in another group [should not influence your thinking]. I think in the end, academics are just like everybody else, you're not convinced by hard evidence or whatever, you can make up your mind on other personal stuff. But research wise it was not good to my mind. (Alwyn Olivier, interview)
Well, in a broad sense RUMEUS and my colleagues' great weakness has always been this [writing up], is exactly this. (Alwyn Olivier, interview)

In contrast, the shortcomings described by Ms Le Roux relate to one of the research outcomes and the developmental aspects of the research. She refers for example to the design of the materials:

I felt I didn't do enough, I didn't have enough time, to really revise the material, and evaluate the material. (Amanda Le Roux, interview)

She also expresses some regret that she could not spend more time supporting the teacher with her professional development, even though this was not one of the research objectives:

Ja, that was one thing that was maybe, you know, if one spent more time with her, but I just felt she had such a heavy schedule herself. At one stage it was almost every weekend, she had to go to some workshop, you know, then it's netball, then it's fundraising. (Amanda Le Roux, interview)

It is interesting to note that the shortcomings expressed here do not in any way cast doubt on the reliability or validity of the research. Clearly, the researchers have a high level of confidence in the way they conducted the research and the knowledge outcomes they produced.

4.5 Dissemination strategies

Three forms of dissemination strategies were used by the researchers. The first was discussion of the research with users, which included themselves, the teacher directly involved in the research process, and the pre-service teachers on their courses. In addition, both Mr Olivier and Ms Le Roux describe instances where they discussed the research with other teachers at conferences:

I for example, I know I did an analysis of an episode that I observed for example, in that plenary, AMESA 99 that I did, where a problem-solving situation, the protocol of interaction there, for example, clearly showing that children of different abilities have different contributions to make in this learning situation and that everybody is learning. (Alwyn Olivier, interview)

And then after the last AMESA conference, I was approached by a few teachers, again it was too short. I showed a few videos and I shared a few things and there were a few teachers who approached me, and I asked them please contact me again. (Amanda le Roux, interview)

Ms Le Roux also describes occasions where she discussed the research with other academics and educators:

At some stage we used to have little, bymekaarkoms [trans: get together] [in the faculty], where people would present their research, [], I've done that twice. [] We used to have to, you know, if you're going to a conference you had to report to the department, in departmental meeting and then also in the faculty, [], especially if the faculty contributed to your funding. [] I did talk to Chris Reddy for instance because he works with teachers, so we sometimes share, but that's more informally.

Ja and then there was the Western Cape Teacher Education Research Forum¹⁸, which I think Chris and Hanie Menkveld [co-ordinated], they have a forum every year where they ask us to present at, so I did that also. (Amanda le Roux, interview)

The third dissemination strategy was of course academic publications. To date, only one of these has been published in an accredited journal.

5 Mode of knowledge utilisation

In this section we look at the approach to knowledge utilisation within this research project and consider who the users and beneficiaries of the research are, and what the nature of knowledge utilisation is.

5.1 Researchers' thoughts on utilisation

We argued earlier that this research project was driven primarily by the intellectual concerns of the researchers for new knowledge. There was however also an awareness of the potential use and applications of this knowledge. This was confirmed by Mr Olivier:

We had a very specific view of our job, which is threefold: lecturing, research and community service. Basically in all the work we do, we try to correct, at least our teaching. So it would have always been on the cards that we doing research on the one hand, is to develop theory, but it would always be clear from the beginning that we then use those theoretical insights and materials also in our teacher, nearly said training, education. (Alwyn Olivier, interview)

The researchers thus saw themselves as obvious users and beneficiaries of this research. In talking about the role of the teacher in this research project, Mr Olivier describes the teacher as another user of the research:

¹⁸ This is an informal regional network forum for teacher educators, in which education faculty and staff members from the five Higher Education institutions in the Western Cape participate, as well as representatives from the South African Qualifications Association (SAQA) and the Western Cape Education Department (WCED). The forum is a space for presentation of research and sharing of practices. (Chris Reddy: personal communication).

The planning took place around this table, and the teacher was not around this table, so we really went back with finished written materials, which was then discussed with the teacher, but the teacher did not so much participate in analysing, reflecting on what was happening, and trying to show this to the diagnosis, prognosis kind of stuff. So the teacher was more a user of this stuff. (Alwyn Olivier, interview)

This comment would appear to contradict the earlier argument (see 4.1) that perhaps the teacher can be viewed as a research collaborator. However, in the above comment, the project leader does not acknowledge the role the teacher played in generating the texts (mostly learner-learner interactions) that were analysed, which formed the basis of that earlier argument. In Section 5.2 we will return to examine the teacher as user and beneficiary of the research.

Curriculum policy development was another context identified for potential use of this research. However, with respect to this context, Mr Olivier was quite sceptical about the value of utilisation of this research:

Of course I want to see ideas applied, used, influence the curriculum etc, but, implement this going to scale nonsense, is a very complicated issue. So we are not, [] working on this problem of going to scale. Going to scale is different, brings in totally different problematics, the biggest problem is to think, just because you did it in one class, one group or with your students, did it in five schools, or ten schools, that this can now be applied in the country as a whole, that is pathetic thinking. (Alwyn Olivier, interview)

The views expressed by Mr Olivier reflect the modest expectations they had of utilisation of the research by users other than themselves. These modest expectations were also expressed by Ms Le Roux when talking about her B.Ed students¹⁹ as potential users of the research:

[The students] try to when they go on practice teaching, they try to use [our approach] in that way, but it is very difficult, [] we have to rely on the goodwill of the teacher, so [they can't] go there and say, you can't teach and we want to show you how to do it, they come back with a huge reflection thing, after they get back from practice teaching, and they observe and they can see the effects of traditional teaching on the children and the work, so they're very critical like that, I think that is one thing that happens. How they will do it in their own classes I don't know. (Amanda Le Roux, interview)

Ms Le Roux expressed similar reservations when commenting on the potential the teacher (Ms B) has for using her experience on the research project to influence the practice of other teachers in her school:

I don't know. Mr D [the principal] says yes, but I'm not so sure, because, [Ms B] is not strong enough, you know, I don't even think she has a leadership position in the school. It's very difficult Jaamiah, to do it, you know, you have to believe that it can work, otherwise, you know like even with Ms R (a different teacher), she's been through all the

¹⁹ These are pre-service primary school teachers.

workshops [] but it's not easy, and it's a total mind shift, and it's not something that you can achieve easily, so I was just lucky that I got [Ms B].
(Amanda Le Roux, interview)

It seems that the researchers really only had confidence in themselves as effective users of the research. This did not mean that they also thought that they were the only beneficiaries of the research. In fact, both Mr Olivier and Ms Le Roux spoke at length about the benefits of exposing the teacher and B.Ed students to this research. In the next section we will look in more detail at how the researchers describe the benefits of the research to the teacher and the B.Ed students.

5.2 Nature of utilisation

In this section we will discuss separately researchers, teacher and B.Ed students as users and beneficiaries of this research. We will look at the contexts in which they use the research, what they use it for and how effectively they use it.

Researchers as users

The researchers use the research in two contexts. Firstly, their teaching context, specifically the B.Ed courses for pre-service primary teachers and secondly, the context of materials development.

Utilisation for teaching

Ensor (1999:4) describes teacher education as a practice “concerned with the transmission of a privileged teaching repertoire”. By teaching repertoire, she means the “set of practices from which teacher educators (and teachers) draw in the elaboration of their pedagogic practice in lecture halls and classrooms”. Ensor describes how a mathematics teacher education programme, of which the B.Ed courses would be an example, constitutes a notion of ‘best practice’:

In the context of teacher education, a repertoire is described as privileged in that it incorporates a particular selection of mathematical content and pedagogic resources for the production of mathematical tasks and the arrangement of these into sequences of lessons. The privileged repertoire also includes features of classroom arrangement, the regulation of teacher-pupil communication and the deployment of appropriate forms of assessment. In other words, the privileged repertoire constitutes (and is constituted by) a notion of ‘best practice’. The specific nature of a privileged repertoire, the particular instantiation of ‘best practice’, depends on the particular teacher education programme under consideration” (Ensor, 1999:4).

The teaching context, in this case study, is a site for knowledge transfer to practices in the classroom. It was with this in mind that the author obtained permission from Ms Le Roux, the principal investigator, to observe six of her B.Ed third year classes, in which she was going to deal with the teaching and learning of fractions. She informed the author before observation took place that she often uses data from the research project on the B.Ed courses that she teaches. The purpose of the observation was not only to witness the extent to which she used the research data in her classes, but also to look at how she

uses this data, for what purpose and what notion of 'best practice' was being relayed²⁰ in this context.

In the six sessions observed, video footage of lessons from the research project classroom, transcripts of actual dialogue between learners in the research classroom and the same or similar mathematical tasks that were used with learners in the research project, were analysed and discussed with the student teachers. The video footage typically showed a group of learners working on a task and captured their conversations as they grappled with the problem as well as interventions by the teacher or researcher, in this case, Ms Le Roux, and conversations she had with the learners. This footage was then used to analyse and discuss learners' misconceptions about the mathematics, how learners articulate their thoughts about solving the problem, the nature of the task learners were engaged in, the challenges learners faced working in groups and the role of the teacher in managing the groups. The form this took in the sessions was mostly conversations between Ms Le Roux and the students, with Ms Le Roux posing specific questions, related to the video footage, for students to reflect and comment on.

Actual transcripts of learner conversations were also given to students to analyse. The analysis of the transcripts focused specifically on the nature of learners' discourse and an analysis of how learners make and substantiate their arguments. In these sessions, the students had to use Toulmin's schema, referred to in Section 4.2, to identify the 'claims' learners made and the 'warrants' and 'backing' they used to substantiate their claims. The sessions that focused on the mathematical tasks learners were engaged in, in the video, drew particular attention to the value of meaningful (everyday) contexts in these tasks, the sequencing of the tasks to reflect a particular progression of conceptual development of fractions, the shortcomings of the tasks, the challenges learners faced doing the tasks and the potential for teachers to design similar tasks.

In all the sessions, Ms Le Roux made constant references that reflected her theoretical orientation and engagement with socio-constructivist literature and theories of learning, and her notion of 'best practice'. For example, she would refer to the "social norms" in the classroom and distinguish between "mathematical authority" and "social authority" in a group; she would talk about the facilitative role of the teacher and how important it is for the teacher to "negotiate meanings" with learners, to "re-voice" what learners say in order to help them formulate their explanations and she would reflect on the kinds of questions the teacher asked the learners; she spoke often about the need to create a "classroom culture" in which learners are free to express their ideas and be given the opportunity to "go through their own thinking processes" and to be able to explain the mathematics in ways that was understandable to their peers; she would refer to the different "models" learners use to express their understanding of the mathematics and point out how to recognise learners' misconceptions. These references were mostly made in relation to either the video footage or the transcripts of learner conversations. Throughout the sessions Ms Le Roux frequently related her own experiences in the research context in relation to the teacher and the learners, often consulting what looked like her field notes.

²⁰ According to Ensor (1999:7), who draws on Dowling (1998), "relay describes the transmission of practices in one activity (for example, initial mathematics teacher education) which are intended for elaboration in another activity (for example, school mathematics teaching)".

In this teaching context, Ms Le Roux attempts, what Ensor (1999:8) describes as the “transmission of recognition and realisation rules²¹”. The transmission of recognition rules enables the students to describe ‘best practice’ discursively, while the transmission of realisation rules enables the students to implement ‘best practice’ in mathematics classrooms. Ensor (1999:8) asserts that access to recognition rules equips the students with a “professional teaching argot”, that is, with a vocabulary and modes of argument to describe ‘best practice’. If this “professional argot” or vocabulary is elaborated in the classroom context, in other words, students can see exactly what the ‘words’ mean, then they are potentially also given access to realisation rules. However, if the latter is not the case, the “professional argot” or vocabulary becomes ambiguous with respect to its potential realisation in practice. We can argue that, through the video footage and learner transcripts, Ms Le Roux creates a ‘virtual mathematics classroom’ in her B.Ed lecture and in so doing, gives students greater access to articulate, and themselves practice, what it means to, for example, ‘negotiate meanings with learners’ or ‘create a classroom culture in which learners are free to express themselves and go through their own thinking processes’. In a later section, where we discuss student teachers as ‘users and beneficiaries’ of the research, we will look at how the student teachers respond to the contents of the course.

Let us turn now to consider what this context means for the researchers as ‘users’ of the research. Weiss (1980, quoted in Nielson, 2001) identifies the following five criteria to assess the usefulness of research, that are often cited by users of research:

- ⤵ Research quality (e.g. objectivity, reliability, validity)
- ⤵ Action orientation (e.g. explicit recommendations, clear course of action)
- ⤵ Conformity to own expectations (e.g. compatible with own ideas and values, consistent with previous knowledge)
- ⤵ Challenge to status quo (e.g. challenges existing assumptions, implies need for major change, offers new perspective), and
- ⤵ Relevance to users’ work (e.g. direct fit with user’s job responsibilities).

Drawing on the criteria suggested by Weiss (1980), the observations of the B.Ed sessions suggest that the utilisation of the research in the teaching context is a direct result of its relevance to the user’s work responsibilities, that is, the researcher’s responsibility to educate prospective teachers. Since the researchers are themselves the users, there is an obvious compatibility with their own ideas and an assumption of the research quality, that it presents reliable and valid data which can be used to hypothesise or draw conclusions about, for example, the way learners construct arguments and make meaning in mathematics.

With respect to the function research plays in the utilisation context, Weiss (1991, quoted in Nielson, 2001) distinguishes between the following:

- ⤵ Research as data (data used mechanistically)
- ⤵ Research as ideas (data lost, ideas remain), and
- ⤵ Research as argumentation (selected data used for advocacy).

²¹ Ensor draws on the elaboration of these terms by Bernstein (1990).

Again following Weiss (1991), the research has multiple functions in this context. On the one hand the research serves as data on teaching and learning that can be used and analysed, and on the other hand, its underlying theory of socio-constructivism and problem-centred learning is used to frame the classroom discussions and to promote a particular model of teaching or notion of 'good practice'. Weiss (1991) would describe this form of 'use' as research functioning as "ideas" and "argumentation" in the utilisation context.

We return to the interviews with Mr Olivier and Ms Le Roux to see what their motivation is for using the research in this context. Firstly, Mr Olivier asserts that he uses the research to illustrate the "academic" mode of inquiry, that is, using logical reasoning to accept or reject an idea:

The very nature of the academic enterprise is to struggle to understand logical reasoning, and pushing [the students] right from the beginning of the year very hard. In my class, there is no such thing as opinion. Opinion is irrelevant, it doesn't count, so they don't have to regurgitate whatever I offer them, they can say anything they want, but it has to be substantiated in an academic way, and then to say whatever. [] You can say whatever you want, provided you base it on a good theory or good research, okay. [] To become a good teacher you build up your own theories over time of what is difficult etc for children. We don't have the luxury of having teachers take five, six, seven years to build up experience of this, so I try to bring that stuff into the classroom, as evidence, not what I say, it's irrelevant. If I say it's irrelevant their opinion is just as irrelevant as what's mine. [] How children interact, a video clip can show what is happening, whether children find something difficult or not, or misconceptions they have, or whatever, a written result, a video or analysis is there, there it is, it's not I, it's not my opinion, and I don't allow their opinion. Now they must make up their mind, okay so I try to practice what I call the academic way, logical reasoning to come to accept or reject any claim. (Alwyn Olivier, interview)

I think [the research] gives them the opportunity to see, to see that it is a real life classroom that they could be teaching, yes, I couldn't claim anything more, my theoretical stance is clear, put it in front where they are convinced by it, changed by it, not just be an opinion. (Alwyn Olivier, interview)

We see here that he also talks about using the research as "evidence" to back up what he has to say about, for example, learners' misconceptions in mathematics. Ms Le Roux seems to draw her motivation for using the research from the effect she thinks it will have on her students as future teachers:

Well, I want them to teach in that way, you know, and I think the emphasis on analysing the material, is very important, and even if they land in a position where they've got to teach traditionally, I think that can be of use to them, [] because it is not easy, to teach in this way if the whole school is not structured in that way, but I think that would make them better teachers, because there's always an underlying theory of how children learn. [] I think one of the bad things of training teachers is that, and I see that in

the other subjects, the teacher is a performer, you know, the teacher has to present something, and you think about your own performance, this is how I did it, and pow, now I remembered there's something I want to try, and [in our approach] the emphasis is on what do I want the kids to achieve, [] what do I want the kids to be able to do, and therefore I've got to keep that in mind when I select my material, so I've got to analyse the material, I've got to see it in that way. (Amanda Le Roux, interview)

[The students] don't see the classrooms, they don't see the classrooms in this way, as part of their practice teaching, so that is why I try to show them the videos, so that they can see how it can be done. (Amanda Le Roux, interview)

The above comments confirm the assessment from the observations of the B.Ed lectures, namely, that both Mr Olivier and Ms Le Roux in this context view the research as data, which can be used to make and substantiate their hypotheses about the way learners learn and make meaning in mathematics, and as ideas to promote a particular theory and model of teaching and learning. In addition, we see a strong motivation, particularly from the principal investigator, to use the ideas from the research to influence the teaching practice of these pre-service teachers and to challenge the pre-conceived notions they have of teaching and learning in mathematics. She admits though that the latter is quite difficult to achieve:

I battled to get a mind shift in my students, you know, they always fall back on, you know, you have to show the children, you have to be the teacher, you have to guide them, and guiding I think is not what I had in mind, because if you guide, then you still go in front, you know, instead of putting the kids in there and seeing what they can do themselves. So it's not easily achieved, and I [] don't think it's in my capacity to be able to achieve that. (Amanda Le Roux, interview)

I won't claim that I have changed [the students], I try to get them to be critical, and to think about that, but I know how deep rooted those things are, and you tend to teach the way you were taught, it's very deep in them. (Amanda Le Roux, interview)

These comments reflect that, even though Ms Le Roux uses the ideas from the research extensively on her courses, and consciously attempts to give student teachers access to recognition and realisation rules to put these ideas into practice, she is not very confident about the transfer and impact of these ideas on the future practice of her student teachers.

Utilisation for materials development

The development of learning materials is the second context in which this research is utilised. According to Mr Olivier a lot of the fraction materials given as tasks to learners and adapted in the research context, have been used directly in the school mathematics textbooks that they have written²². In addition, classroom data from the research project

²² Except for the research assistant, the research team members are all joint authors of these textbooks.

have also been used to produce modules for an 'e-degree', an internet based course of study for pre-service teachers. He explains:

Amanda put the stuff into the so-called e-degree. e-degree is a private company putting courses on the internet, so there are university courses etc, that's done through e-degree. Now e-degree, on an experimental basis worked with Amanda, and this was formulated, so Amanda used, we used the videos from the class, analysis of children's work etc into this e-degree format, which was like, you had Amanda talking for example, and so you click here and boom, they could look at a video of children in the classroom, they could analyse children's work. (Alwyn Olivier, interview)

That was a very specific effort to take this research in its practical form, mainly using the videos, using the results etc, to make really a self-standing, independent little module for students. (Alwyn Olivier, interview)

You should look at that e-degree thing, it was, you know everything is under pressure so, we didn't really use the medium that effectively, but I think, I would do it differently, and then of course, we were immediately restricted, what is a better word, constrained, by the medium, but I think it was, the message was good. (Alwyn Olivier, interview)

In this context we see that while the research is again used as data, it is also likely that selected data is used as 'advocacy' to privilege or promote a particular model and theory of teaching and learning. There is once again an assumption of the quality of the research in terms of its reliability and validity for use in this context.

Teacher as user and beneficiary

In Section 4.1 we argued that the project teacher was a research collaborator because she was an active participant in the research process insofar as she co-taught the materials and facilitated classroom discussions. As such, she contributed to creating the appropriate conditions for the collection of data on learners' interactions and discourse. The interactions between the researchers and the teacher, also described in Section 4.1, suggest that the teacher was certainly exposed to the ideas from the research and likely benefited from this.

Ms Le Roux describes below what she thinks the benefit of participating in this research project was to the project teacher:

I think being able to organise, to structure her classroom, you know, to get that classroom culture. (Amanda Le Roux, interview)

On the basis of reports Ms Le Roux received from her B.Ed and M.Ed students, she believes that the project teacher has internalised the research ideas and incorporated them into her everyday teaching practice:

I sent my fourth year [students] there, I think I told you that, last year, because our students never see a problem-centred classroom, there's none in Stellenbosch at the moment, [] and they went and they came back and they said they were so impressed, you know, because you can almost feel the atmosphere in the classroom, so I think that is it. [] And I spoke to

Therine²³ and I said, it was my experience with , I did a little bit of community development work when I lived in Franschoek, you know, working with women's groups, and you know, when you're not there anymore it just falls flat, you know, and I was very afraid that this might happen to Ms B, that when I don't go regularly, you know, where there's no support, because there's nothing really in it for her, and Therine said no, she saw it was pretty much her way of doing, that she had accepted that. (Amanda Le Roux, interview)

While we have no other evidence of why or how the teacher used the research²⁴, it seems likely that the teacher would use the research ideas to improve her own practice in the teaching of mathematics. Unless the teacher actively set out to influence or improve the practice of other teachers in her school, she would have no need to use the research as data in the way that the researchers use it on their teacher education courses.

Student teachers as users and beneficiaries

From the comments in Section 5.2 by Mr Olivier and Ms Le Roux, we see that in their view the research is of great benefit to the B.Ed students because it exposes them to the realities of classroom teaching, it shows them examples of learners' difficulties and misconceptions, it shows them examples of how learners argue and reason mathematically and it models a particular way of teaching and theory of learning. However, they express some reservations of the capacity of these students to use and apply the ideas from this research in their teaching practice.

Ms Le Roux describes, for example, the teaching practices of some of her former students:

We've had some good students here that did very well and then they go to the schools. I know of one student who had passed cum laude, but I had that feeling this [student] doesn't believe, you know, she gives me what I want, but I can see she's still, and she teaches very traditionally, and she's at Eikestad, while there are others who didn't maybe do as well [on the course], but I can see they understand the process, and so I don't really know. (Amanda Le Roux, interview)

The interviews that were conducted with four B.Ed students suggest that they certainly recognise the value of the research for their future profession and can articulate many of the core ideas that emanate from the research. In terms of the value of being exposed to the research in the way that they were on the course, one student practically echoed what the researchers said:

Well, we had those two videos, which we watched. While [Amanda's] teaching she will say, she did this workshop or she did this with some teachers and these were the problems that came through. [] And then she'd say [] , the teachers would say this and this and this, these are the problems that the kids came up, so you would have very experience of what

²³ The M.Ed student who was also using data from Ms B's class.

²⁴ The only reliable way of assessing what ideas from this research the teacher has taken up and how she applies it, is by observing her teach, and the limited scope of this case study did not allow for such an investigation.

kids experience, and you'd have experience of what the teachers experience and then that combined, then [Amanda] gives that to you in class, so you have sort of a variety of different problems, misconceptions, whatever, that children and the teachers experience together, and so once you finish with it, you sort of, oh, okay, so this is what I've gotta be aware of, this is the sort of problem I might encounter, this is what other teachers, that other teachers that I might teach with, will also have problems with. (Student 2, interview)

The following were some responses to what the students thought were the key ideas that came out of their course to bear in mind in the teaching and learning of fractions:

Ja, learning fractions is a process. You start in grade 1 or grade 2 or wherever and you work through till grade 7. You can't decide that in grade 1 I'm going to do subtraction, in grade 2, I'm going to do multiplication, in grade 3.... It doesn't work that way, you have to start by giving everything so that they get exposed to as much as possible, but then develop the skills through the years. It's not like doing specific things at specific grades, that firstly. Secondly, I would also then say again, "problem-gesentreerd", working with a problem so that you know what you're solving actually, not just doing maths but solving an actual problem. And thirdly, working with a context, because [], it's easier for children to understand, it's easier for them to talk about it if, it stimulates group work and group work activities also. Ja, and then fourthly [], you don't really want a child just to do subtraction of fractions, you want them to understand what they're doing, you want them to link to the real world, where are they actually gonna use this. (Student 1, interview)

Key aspects....I think that it's never to give straight hand [], how to work out fractions, where fractions come from. I think that the learners first have to figure that out, [] not necessarily figure it out, [] of thin air, but sort of, you need to guide them through structured activities so that they are eventually there, but you need to be very prepared, because that's what I found that, if you're not prepared and you don't plan ahead, then you're just giving activities and it's not going anywhere, you know, and [] I think that's one of the important steps is, through the activities you need to know what's in each activity so that it builds on the next and the next and the next, so that it forms like a pattern you know, steps, I think ja. (Student 2, interview)

Well, I think the most important thing's to make it contextually based, to work with a context that the learners can understand, firstly, so that they know, they've got somewhere they can start where it's meaningful. [] To let, learners grapple through the process, firstly, to give them real life contexts where they've got decisions to make for themselves. (Student 3, interview)

Here we see that the students reflect an awareness of the centrality of contextual problems to the learning process, the importance of allowing learners to grapple with problems on their own and the need to structure activities that ensure there will be conceptual understanding of working with fractions. The students were

also able to talk about the facilitative role of the teacher and the importance of learner-learner interactions:

[The teacher is] there to facilitate the children, or rather to guide them to what they're learning, you're not there to learn (sic) them actually. Your word isn't supposed to be their knowledge, they're supposed to actually try and develop themselves, see for themselves, make their mistakes, you are only there to help them to better on that". (Student 1, interview)

Firstly, your teacher has got to know exactly what you want from her learners, but, and the learners need to know what's expected of them, like to be able to discuss and, I think that comes from the teacher empowering them with the responsibility to give, to give feedback, to provide an opinion, especially to have an opinion and then to share it with the class without fear of, you know, being put down by other class members and so that brings in a lot of the social side of the classroom routine, and I think that is such a key aspect from maths, that you don't always consider it, it's easy to just think of it as a procedural thing and a teaching concept, but the way that you do it is important. (Student 3, interview)

The interviews with the student teachers show that they certainly have acquired the vocabulary and mode of argument to describe a model of 'best practice' as reflected on the B.Ed lectures. They have developed what was referred to earlier by Ensor (1999) as a "professional teaching argot" which serves as evidence of having acquired the recognition rules to describe their teaching contexts. The student responses reflect, for example, some of the insights they have gained into the role the teacher has to play in creating a classroom environment in which learners are encouraged to argue and articulate their thoughts on the mathematics. One might expect that with these insights the students would be quite confident about using and applying these ideas when they go and teach, that is, to realise these ideas in practice.

In fact, all of them expressed deep reservations about their capacity to do so:

[Amanda] doesn't want us to teach with the children, she wants [the children] to "ontdek" (discover), ja, discover the maths, and that's also a problem we have because that's not the way we were taught, so normally there is a bit of confusion between her and us because she is already in her mode of thinking while we're not, we're still thinking that rather prevent the whole like, whole number misconception, so tell them that a fraction is not a whole number, the one thing is one, and she says no, let them make the mistake and then you try and prevent it in the future. [] We're still trying to make the switch in our heads because we were taught this way for twelve years, so we don't really see what the motivation behind that can be. (Student 1, interview)

When I [tried to do] one or two activities that I got out of the MALATI , [with students on my teaching practice] they couldn't, they didn't really want to do that, they weren't quite up to it, and they weren't really used to group work at all, so, it really, it failed, dismally, and I looked really stupid.

Teachers were like, what are you doing? So, I sort of left that part, and said never mind, because ... (Student 2, interview)

No, I don't know, I have been in schools now, it's quite scary how, you don't even know where to start with some of the kids because they don't know what's going on, really they don't know what's going on and it's quite daunting for a teacher. (Student 2, interview)

I did try and get a bit of discussion [when I taught] but I realised you need to have a bit of structure and that you can't just let there be discussion all the time, its, it works when you've practiced and you've built up a rapport with you class on the way you want things to be done, but I think it's a process of growing towards that and they haven't had that before hand. The class that I had was quite good at discussing but they were also very bright, so they didn't have as much to grapple through, they got it quite quickly. (Student 3, interview)

I think [this approach] is the ideal way in OBE, but sometimes, I think that if I've got to apply that in classroom it won't work that well. I think it works for students, but I'm a little bit not, I'm not sure if it'll work with children, not all the time. (Student 4, interview)

We cannot at this stage describe the B.Ed students as proper users of the research, but they certainly are potential users by virtue of having been exposed to the research data and ideas and by the fact that the research does have immediate relevance to their future professional practices. The comments above, however, indicate that the students have strong reservations about their capacity to use and implement the research ideas in their own teaching. These reservations suggest that the B.Ed lectures are not that effective in the transmission of realisation rules, that is, the means by which students can implement and apply their notions of 'best practice' in the mathematics classroom. While this might be one reason why student teachers struggle to implement learnt notions of 'best practice', studies by Davis (1995), Galant (1994, 1995), Ensor (1999) and Jaffer (2001), also highlight aspects of the social context of schools, which underscore the perception of the student teachers, that the school context can severely constrain the realisation of teaching ideas and strategies in practice.

Davis (1995) and Galant (1994) investigated the relationship between an in-service mathematics teacher education programme and classroom teaching. They were specifically interested in recontextualising²⁵ – how teachers recruited practices elaborated on an in-service programme and used them in mathematics classrooms. Ensor (1999) conducted a two year longitudinal study that tracked seven student teachers through a mathematics method course of a Higher Diploma in Education (HDE) programme and then into their first year as beginning teachers. She looked at the structure of the course and what was being transmitted and the ways in which teachers recontextualised from this course as beginning teachers. Jaffer (2001) also looked at the way teachers recontextualised

²⁵ This term was derived from the work of Bernstein (1990) who used it to describe the process by which knowledge is appropriated from one context and then re-described or re-interpreted when used in another context.

practices, but her focus was on the recontextualisation of the practices modelled in a mathematics textbook, when the textbook is incorporated into the mathematics teachers' classrooms. All these studies found that the teachers and student teachers had developed ways of talking about teaching and learning mathematics that reflected the notions of 'best practice' transmitted in the courses and the textbook, but the practices were either selectively implemented in their classrooms, or took on a very different form in the classroom to what the teachers intended. They argue variously that the social context of the school and classroom impact on the way teachers are able to recruit and use practices, elaborated on the courses or in the textbook, in their classrooms. Features of the social context of schools and classrooms highlighted in these studies include, the social relations established between teachers and learners, the pedagogic identities established for teachers and learners, the social relations between teachers and other teachers and the extent of regulation of teachers' practices imposed by school authorities (including principals, head teachers and the curriculum). What these studies show is that the social and moral order in the school and the classroom, established through the features mentioned above, is very different to that exhibited in the pre-service and in-service programmes and the textbook, and that this severely limits and restricts the possibilities and potential for teachers to implement practices and ideas recruited from these programmes or the textbook.

Attention is drawn to these studies because they point to the complexity of teacher education contexts, in which the researchers are the primary 'users' of the research, as a site for knowledge transfer to practices in the classroom.

6 Conclusion

The mode of knowledge production and utilisation described for this project reflect an expanded 'science-push' model of utilisation, where the researchers are the main source of ideas for directing the research. In this expanded model, the research is viewed as having an immediate value in the academic and professional contexts of the researchers and more long-term strategic value in its contributions to changing teachers' classroom practices. The primary influences on utilisation are the content attributes of the research, that is, the validity, reliability and applicability of the research, as well the social contexts of schools and classrooms in which the theories and practices can be implemented.

The research was driven primarily by the intellectual concerns of the researchers for new knowledge on how children learn and talk about mathematics, on the types of problems learners should be given to stimulate their thinking and get them talking or arguing, and on strategies teachers could use to manage and facilitate learning. Insofar as this new knowledge could have practical applications in the classroom, the research can variously be categorised as basic strategic research, academic research or planning and instrumentation research.

The primary focus of the research was always the advancement of knowledge and the improvement of practice, in the field of mathematics education. As such, the research outcomes are best described as epistemic outcomes. That is, they provide new insights into the way children talk and construct arguments in mathematics, they suggest a particular model of teaching that is problem-centred and encourage learner-learner

interactions, they hypothesise about the cognitive development of fraction concepts for learners, and they provide new insights into the construction of fraction learning materials.

The researchers use the research in two contexts. Firstly, their teaching context, specifically the B.Ed courses for pre-service primary teachers and secondly, the context of materials development. Within these contexts, we see that on the one hand, the research serves as data on teaching and learning that is used and analysed, and on the other hand, its underlying theory of socio-constructivism and problem-centred learning is used to frame the classroom discussions and materials, and to promote a particular model of teaching and learning and notions of 'best practice. In other words, the research also functions as 'ideas' and 'argumentation' in the utilisation context. Since the researchers themselves are the primary users, there is a basic assumption of high validity and reliability of the research data, and observations of B.Ed classes show that the research is used effectively and extensively to inform the content of the courses.

Although we have refrained from describing the B.Ed students on these courses as proper users of the research, we have acknowledged, on the basis of how students talk about the content of the course, that they are potential users by virtue of having been exposed to the research data and ideas and by the fact that the research does have immediate relevance to their future professional practices. This potential for utilisation also means that the teaching context of the B.Ed courses, as a site for knowledge transfer, presents an opportunity for the research to be utilised and disseminated through a multiplier effect. That is, one researcher exposes 30 pre-service teachers to these ideas; once qualified they go into schools to teach, and then use these ideas and so expose their colleagues to these ideas who can then also use them in their teaching practice. Meanwhile, a new cohort of pre-service teachers who enter the B.Ed course are exposed to the research data and ideas and so the cycle continues. Taking this optimistic view, we can describe the utilisation of the research in this context as a grand and very effective dissemination strategy for the research. However, teacher education research highlighted in this study, presents a sobering view of the complexity of teacher education courses as a site for knowledge transfer of practices to the classroom, and they suggest that the articulation of knowledge between different social contexts (e.g. B.Ed course and the classroom) needs to be understood as a process of recontextualising rather than transfer and that this process is subject to the social and moral order established within each context.

Data sources

Face-to face interviews

- Ms Nicoleen Schoeman (Third year B.Ed student), October 2003
- Ms Samantha Marais (Third year B.Ed student), October 2003
- Ms Angela Rob (Fourth year B.Ed student), October 2003
- Ms Petro Du Preez (Fourth year B.Ed student), October 2003
- Ms Amanda le Roux (Principal investigator, RUMEUS), November 2003
- Mr Alwyn Olivier (Director, RUMEUS), March 2004

Observations of Third year B.Ed Lectures

- Ms Amanda le Roux (lecturer), 26 and 27 May 2003, 19, 22 and 29 August 2003, and 1 September 2003

Questionnaire

- 'Public sector R&D in South Africa: The production and utilisation of research' questionnaire completed by Ms Amanda le Roux, 2002

Project documents and publications

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CASE STUDY 15

THE CO-ORDINATED AVIFAUNAL ROADCOUNTS (CAR) PROJECT

Big birds, cars, ‘birders’ and farmers

An on-going research and monitoring project in the Avian Demography Unit, Department of Statistical Sciences, University of Cape Town

By Tracy Bailey



The Blue Crane, South Africa’s national bird. Photograph courtesy of the Avian Demography Unit, University of Cape Town.

CONTENTS

Abbreviations	633
1 Introduction	634
2 The Avian Demography Unit (ADU)	636
2.1 Historical sketch	636
2.2 Nature and organisation of the research	638
3 Overview of the Co-ordinated Avifaunal Roadcounts (CAR) project	646
3.1 Project initiation, objectives, research questions and potential value	646
3.2 The annual CAR project process	648
3.3 Stages in the development of the CAR project (1993-2003)	651
3.4 Project funding	654
3.5 The CAR project team	656
4 Mode of knowledge production	658
4.1 The nature of the research and the research process	658
4.2 The 'roadcount' method	659
4.3 Project outputs and dissemination strategies	660
5 Mode of knowledge utilisation	662
5.1 The intended users and beneficiaries of the CAR project	662
5.2 Examples of utilisation	663
5.3 Support and interaction with users: Bridging the 'knowledge gap'	670
5.4 The need for long-term data collection for effective utilisation?	671
6 Concluding observations	672
Data sources	675
Face-to-face interviews	675
Telephonic interviews/feedback discussions	675
Email responses to additional questions	675
Questionnaire	675
Publications and documents	675
Appendix 1: Broad recommendations of the CAR report	676
Appendix 2: CAR publications	677

Abbreviations

ADU	Avian Demography Unit
BIRP	Birds in Reserves Project
CAR	Co-ordinated Avifaunal Roadcount
CWAC	Co-ordinated Waterbird Counts
DEAT	Department of Environmental Affairs and Tourism
EWT	Endangered Wildlife Trust
GPS	Global positioning system
MSc	Master of Science (degree)
SAFRING	South African Bird Ringing unit
SANCCOB	Southern African Foundation for the Conservation of Coastal Birds
UCT	University of Cape Town

1 Introduction

South Africa is internationally renowned for her biodiversity and boasts significant proportions of animal and plant species in the world. South Africa also has a long and impressive history of nature conservation, beginning with the traditional forms of natural resource management practised centuries ago by indigenous peoples, such as the San, Khoi and Nguni, and the promulgation of legislation for protected areas and the establishment of game and nature reserves in the late 1800s (DEAT 1997, Chapter 1). According to the White Paper on the Conservation and Sustainable Use of South Africa's Biological Diversity (DEAT 1997, Chapter 1), South Africa is ranked "as the third most biologically diverse country in the world, and as such is of major global importance for biodiversity conservation."

Since 1994, the national Department of Environmental Affairs & Tourism of the new South African government has developed a range of policy and legislation with regard to environmental conservation and management.¹ According to the White Paper (DEAT 1997, Chapter 1), environmental policy in South Africa has been developed within the broader context of international developments around the conservation of biodiversity, as well as holistic approaches to nurturing growth and sustainable development. Examples include the United Nations Agenda 21 Framework (global plan of action for sustainable development), and the United Nations Convention for Environment and Development of 1993.

One of the key challenges to contemporary policy development in South Africa is the apparent threats to our biodiversity. Significant percentages of plant, bird, reptile, amphibian, mammal and butterfly species "are listed as threatened in the South African Red Data Books, which indicate the conservation status of threatened species and ecosystems" (DEAT 1997, Chapter 1). The ramifications of these threats go beyond nature conservation into the realm of our economic and social well-being, since we rely fundamentally on these natural systems and resources for our survival.

Underwriting these estimations, understandings and approaches is a long history and foundation of research, both locally and internationally. Environmentally-related research ranges from the collection of data on the numbers, distribution and characteristics of animal and plant species, to the investigation of the 'hows' and 'whys' of environmental processes and change, and the evaluation or assessment of interventions. The enormous scope and diversity of the natural world – in terms of species, geographical spread and changes over time – presents a daunting task for those in the business of collecting and analysing baseline data.

¹ Examples include: the White Paper on the Development and Promotion of Tourism in South Africa, 1996; White Paper on Environmental Management Policy, 1997; White Paper on Integrated Pollution and Waste Management for South Africa, 2000; and, the National Environment Management: Biodiversity Act, 2004.



Blue Crane

Photograph courtesy of the ADU



White Stork

Photograph courtesy of the ADU



Kori Bustard

Photograph courtesy of Donella Young



Secretary Bird

Photograph courtesy of the ADU

This case study documents the initiation, progression and outcomes of a research project which focuses on one aspect of the environmental landscape in South Africa, namely the large terrestrial or ground-dwelling birds, such as Blue Cranes (our national bird), Stanley's Bustards, Abdim's Storks and Secretarybirds, many of which are threatened or endangered. The project is the Co-ordinated Avifaunal Roadcounts (CAR) project at the Avian Demography Unit (ADU), University of Cape Town. The project focuses on monitoring the trends in numbers and habitat use of these bird populations, primarily on agricultural lands.

The project began in 1993 with 15 routes in the Overberg region in the Western Cape, and focussed on only two species – the Blue Crane *Anthropoides paradiseus* and Stanley's Bustard² *Neotis denhami*. Today, the CAR project covers more than 330 routes, mostly through agricultural areas, in six provinces, and focuses on 21 bird species, 14 of these species appear in the Red Data Book as either “critically-endangered”, “vulnerable” or “near-threatened”.

The CAR project has been described as the largest scientific project of its kind in South Africa, involving more people on a single day than any other birding activity. No less

² *The Stanley's Bustard will soon be renamed the Denham's Bustard, inline with international convention (Donella Young, interview, 1 September 2004).*

than 750 volunteers set out in their cars twice a year – on the last Saturdays in January and July – to count these terrestrial birds on designated routes. Around half of these volunteers are commercial farmers and landowners, who have a special concern for the conservation of the wildlife on their farms. Other volunteers include avid “birders” from bird clubs around the country, nature conservationists and even school children.

In 2003, the ADU celebrated the 10th anniversary of the CAR project and published the report **Big Birds on Farms: Mazda CAR Report 1993-2001**³ which includes the findings of the first eight years of the initiative. The report includes data from 2 437 roadcounts on 385 routes, and provides detailed accounts of 15 bird species and 17 geographical regions (precincts). The report also includes a number of general and specific recommendations for landowners, conservationists and the CAR project team.

Before turning to a more detailed discussion of the CAR project, a brief overview of organisational context within which the project is located, namely the Avian Demography Unit (ADU) of the University of Cape Town is provided.

2 The Avian Demography Unit (ADU)

2.1 Historical sketch

The Avian Demography Unit, which focuses on research into the dynamics of bird populations, is quite unexpectedly located in the Department of Statistical Sciences at the University of Cape Town. The history of this relates directly to founder and Head of the Unit, Prof Les Underhill, who has a broad smile on his face when he says: “I think really that the University of Cape Town pays me to do my hobby!”

Prof Underhill completed his PhD in statistics in 1973, in the sub-field of abstract multivariate analysis. Prof Underhill’s career in such fundamental statistics was short-lived, however, as he soon realised that he had “solved a problem that nobody’s ever had!”. So, according to Prof Underhill, he rebelled against his own work, and retrained as a “practical applied statistician”. This work required him to assist academics from across the scientific domains with their statistical queries, which ultimately created a different kind of problem for Prof Underhill:

It’s like if someone comes to this side of my desk describing data, and you work with astronomers one week, you’ve got to learn a bit of astronomy. Then you work with psychologists the next week and you learn a bit of psychology. Then somebody from medicine comes along and you’ve got to learn a bit about heart attacks and the like, to analyse their data. It’s hugely inefficient. So, I gradually gravitated to doing the statistics in the areas I knew something about, which was birds. (Les Underhill, interview)

It took a long time, but eventually, in 1989, Prof Underhill realised that there was a niche for him as a statistician in ornithological data analysis. The Bird Atlas project was transferred from the Percy FitzPatrick Institute of African Ornithology, also at UCT, to Prof Underhill and the Department of Mathematical Statistics (as it was known then), by the Dean of the Faculty of Science in the same year. According to Prof Underhill, this was

³ Henceforth referred to as the “CAR report”.

because there were “major problems” with the way in which the project was being administered (Email, 28 July 2004). The following year (1990), the South African Bird Ringing (SAFRING) unit was also transferred to the Department, for similar reasons. It was these events, which Prof Underhill referred to as “peculiar mishaps”, that made way for the formation of the Avian Demography Unit (ADU). According to Prof Underhill, he and others “invented the Avian Demography Unit as the interface between projects and the Department.” (Les Underhill, interview)

The ADU was established on 1 December 1991 with formal approval from the University Research Committee. At the same time, the department changed its name to the Department of Statistical Sciences, about which Prof Underhill commented: “... isn’t quite as heavy as Mathematical Statistics. It is a better description of what we do.” (Les Underhill, interview).

The first major turning point for the Unit was the Apollo Sea oil spill in 1994. In particular, the Unit’s involvement in this event led to the emergence of a new research focus and, importantly, provided the opportunity for the first PhD degree in a bird-related field to be undertaken in the Department:

What I hadn’t realised taking over SAFRING in 1990 was that one of the things you do in an oil spill is ring the penguins. So totally unprepared, I was given the task of ringing nearly 5 000 penguins and it was a huge effort. If you put 250 bands on penguins your muscles are really sore at the end, let alone the blood that gets lost. And there was no way I was actually going to waste that effort. So, we put in place, I think I motivated it more than anybody else, a follow-up system. And I got my first purely “birdy” PhD thesis, Phil Whittington. And it was a huge battle getting him registered in the Department of Statistical Sciences because he had no mathematics. But we got it right in the end and now I have PhD students with no mathematics since matric! [] So Phil was one of the pioneering ... the first student that went that way. He beavered away, collecting data on re-sightings of Apollo Sea penguins. (Les Underhill, interview)

A second major turning point in the ADU’s history was triggered by the Treasure oil spill in 2000. There was considerable media coverage of the spill, and especially of the journeys of three penguins – Peter, Pamela and Percy. The coverage was also of international interest and, at one point, **Time Magazine** declared Peter as one of their “Winner’s of the Week”. A large amount of data was generated through this involvement, and the ADU acquired a second PhD student. According to Prof Underhill, a major spin-off of the Treasure project was that in 2001, “... all of a sudden dozens of students started coming out of the woodwork wanting to have their MScs and PhDs supervised here.” (Les Underhill, interview)

It also happens that at that time, UCT had expressed a concern that the Unit was not attending to the main mission of the institution, namely teaching and research. In addition to the extremely limited engagement with postgraduate teaching prior to 2001, according to Prof Underhill, the ADU was “... gathering data for research, but not actually doing

research”.⁴ The growth in postgraduate student numbers since 2001 has enabled the ADU to get “back into the main business of the University.” (Les Underhill, interview)

Prof Underhill does not regard the unusual placement of the ADU within the Department of Statistical Sciences as problematic, and says that they receive good support from the university management:

At the end of the day, the placement is superficially unusual, but in fact it is a stroke of genius. There is nothing quite like the ADU anywhere else on the planet. There is nothing quite plugged into the development of statistical methodology as we are. In other words, we see new data analysis challenges as opportunities to do research, not as ruddy nuisances that need a statistician to solve. I think this is slowly being recognized by the powers that be. Our productivity is pretty good (i.e. research output for the money), and we probably are one of the most newsworthy bits of UCT (probably only Tim Noakes’s Sport Science Institute generates more news among comparably sized units). I currently have a huge amount of support from my Head of Department, and he is a great advocate for me up the hierarchy. I don’t think the then Dean and then Deputy Vice Chancellor: Research had the foggiest clue that they were up against someone quite as persistent as I am; if they thought about it at all, they probably thought the ADU would be another flash in the pan outfit (there are lots of initiatives here that get started with great enthusiasm, and never get heard of again!). (Les Underhill, e-mail, 28 July 2004)

2.2 Nature and organisation of the research

The current mission of the ADU is described in one of the Unit’s regular publications as follows:

[] to contribute to the understanding of bird populations and their dynamics, and thus provide input into bird conservation. We achieve this through mass-participation projects, long-term monitoring, innovative statistical modelling and population-level interpretation of results. The emphasis is on the curation, analysis, publication and dissemination of data. (Bird Numbers, Vol 11 No 2, December 2002)

The quote above highlights a number of key features of the research undertaken by ADU staff, including the collection of data on bird populations for monitoring; statistical analyses of population trends; and, the dependence on the participation of a large number of volunteers in the data collection process. There is also a strong emphasis on the dissemination of information to stakeholders in the hope that the results will contribute to conservation policy and practice. It is interesting to note that the CAR project – the focus of this case study – reflects all of these elements. These and other features of the research undertaken are discussed in detail in the following section.

⁴ Ornithological data of the kind collected by the ADU only becomes useful and ‘analysable’ after a period of about ten years. This feature of ADU research in general, and the CAR project in particular, is discussed in greater depth in later sections in this report.

The research staff and postgraduate student complement

Prof Les Underhill is clearly the glue that holds the Unit together: it was his vision and passion for birds that led to the formation of the Unit; it is his statistical background that provided the rationale for an ornithological research centre to be located in the Department of Statistical Sciences; and it is he who supervises the approximately 18 MSc and PhD students currently in the Unit. No doubt, Prof Underhill's stature in the ornithological world⁵ plays an important part in the Unit's ability to attract large projects and postgraduate students.

Having said this, however, Prof Underhill is the first to point out the value of his carefully selected staff in the overall success of the Unit. He clearly appreciates staff who are capable of working independently, given his 'limited interference' management style: everyone has a role to play and Prof Underhill tries to impose as little 'structure' on the Unit as is functionally possible. At the time of writing this report (August 2004), there were 14 members of staff, most of who were involved in research. Many of the 'support' staff are involved in postgraduate research. In addition, three individuals have been seconded to the ADU. They include: Dr Tony Williams and Mr Vincent Ward from the Western Cape Nature Conservation Board, and Mr Nosuko Lugano from the Council for Scientific & Industrial Research (with funding from the Department of Science & Technology).

The postgraduate students come from a diversity of backgrounds in the broad disciplinary fields associated with biology, zoology and ornithology. While historically the majority of postgraduate students were drawn from within South Africa's borders, according to Prof Underhill, more recently there has been a growth in the number of foreign students.

Research focus areas

Research at the ADU is not formally structured into research programmes or research focus areas, except to the extent that research focuses on particular bird species. Instead, the research appears to revolve (and evolve) around particular projects and the individual researchers and postgraduate students. Prof Underhill reported that despite this apparent lack of structure and specific focus, they always know exactly what they will and will not take on, in line with the particular research interests and capacities at that time.

I guess if you want to be a manager in the beginning of the twenty-first century, you have to be nimble. That's what it's all about. You know, you have to grasp your opportunities. So I think we've got a fairly clearly defined idea of what our area of expertise is. It's quite easy to work out whether a new opportunity fits within that circle of expertise and we tackle it, or [it doesn't fit] and we just let it go. [] So I couldn't tell you what we're going to do next year! (Les Underhill, interview)

The last comment by Prof Underhill in the quote above also highlights the indeterminate nature of research; in other words, an apparent coherence or consistency of focus in the spectrum of research being undertaken in the Unit at any point in time is temporary. In

⁵ Prof Underhill has received a number of awards for the work he does, such as the 'Top Ten Conservationist of 1999 Award' from the Endangered Wildlife Trust.

August 2004, the ADU web site⁶ listed the following completed and ongoing projects and research areas:

Completed projects:

- ◀ Southern African Bird Atlas Project: Fieldwork started in 1987 and the project was completed in 1997 with the publication of *The Atlas of Southern African Birds*. In 1999, the project was awarded the John FW Herschell Gold Medal of the Royal Society of South Africa – only one of a number of such awards
- ◀ Important Bird Areas Directory: The Southern African arm of this project started in February 1995 and was funded by BirdLife International and the World Wildlife Fund South Africa
- ◀ Red Data Book for Birds of South Africa, Lesotho and Swaziland, and
- ◀ The Southern African Frog Atlas Project (SAFAP).

Ongoing projects include: South African Bird Ringing Unit (SAFRING), Birds in Reserves Project (BIRP), Co-ordinated Waterbird Counts (CWAC), Nest record card scheme (NERCS), Co-ordinated Avifaunal Roadcounts (CAR), the Mozambique Bird Atlas Project (under the auspices of the Endangered Wildlife Trust), and the Swift Tern Project. Ongoing areas of research include seabird research and weaverbird research.

Implicit in the interview data and the documentation about the Unit is an informal ‘division of labour’ between the ADU staff and the postgraduate students. On the one hand, according to James Harrison’s editorial in *Bird Numbers* (Vol 10 No 1, July 2001), Prof Underhill’s vision for the ADU upon its establishment was to create “a central repository and organizing body for all regional bird populations data.” Examples of these kinds of projects, which are primarily the responsibility of ADU researchers, include the Bird and Frog Atlas projects, the Important Bird Areas project, and the CAR, BIRP and CWAC projects. The primary purpose of these data is to provide a baseline of statistics for monitoring. The identification of trends through the analysis of the data places the ADU in a position to act as an early warning system for potential problems in bird populations. It can also be used to formulate recommendations for policy and practice, or to shed light on the extent to which conservation initiatives or interventions have been effective. Prof Underhill pointed to the CAR project as exemplary in this regard:

A project like CAR is measuring the effectiveness, say, of the broad general population level in terms of what the Overberg Working Group has done in the Caledon area, in terms of more responsible use of pesticides, poisons and reducing the frequency of poisoning incidents. Has it made a difference?
(Les Underhill, interview)

On the other hand, the more in-depth work in the Unit, such as research into breeding patterns, energy consumption and feeding habits, is undertaken by the postgraduate students. This kind of research is primarily about improving our understanding of these features of bird life. They do, however, also have potential practical implications, since they can provide a rationale for a particular intervention or practice by conservation

⁶ <http://web.uct.ac.za/depts/stats/adu/>

agencies. The following two quotes provide examples of postgraduate research in the Unit, and highlight the potential for application:

The follow-up of SANCCOB's oiled penguins. SANCCOB cleans the penguins, lets them go and they really don't care about the penguins again after that. Somebody like Phil Whittington's PhD thesis actually says that those penguins that were released, they survive really well. They don't seem to carry any survival [impediments?] compared with penguins that have never been oiled. But Anton's [current PhD student] thesis says that a fair proportion of those cleaned birds never breed again. And it's that [] kind of conservation intervention [e.g. capturing and cleaning penguins] which is not carefully followed-up and monitored. And that's part of the role that we see ourselves playing, one way or another. (Les Underhill, interview)

René Navarro is working on gannets and he's looking at whole family energetics. [Both chicks and adults are dosed] with doubly-labelled water. At the same time they get a GPS logger on their backs. You can actually track the exact route that the birds take and you can look at the energetics of flying all that distance in relation to the amount of food that they bring back to their chicks. And that helps us understand, from a conservation viewpoint, the margin of error in breeding. [] We can work out how much energy they are using, and ultimately identify the slack in the system, because obviously there are good years, where there's lots of food and it's easy to find and they feed their chicks relatively easily and the chicks grow fast. And then you have bad years, during which parents struggle to find food for their chicks. The whole thing balances on a knife edge. So even this kind of research, ultimately, we think has got some possible practical application. (Les Underhill, interview)

In this sense, the overall research orientation at the ADU – among both staff and postgraduate students – can be described as 'strategic' research, since the researchers are aware of the range of potential users and potential applications of the data they are collecting. In some cases, the research is more applied in nature, such as is the case with the occasional contract work that the Unit takes on; while in others, research is undertaken purely for 'curiosity's sake'. As Prof Underhill put it: "We also do things which are just research, for the sake of doing research, where we are [traditional] academics."

There is therefore a link between the larger, monitoring-type research that is undertaken by ADU staff, and the more exploratory 'why' and 'how' questions asked by postgraduate students. In addition, it is anticipated that the large datasets that have and are currently being developed, will form a useful basis for PhD studies.

The CAR project therefore does not fall within a particular research programme or focus area. Instead, it forms part of this growing “repository” of ornithological data which, according to Prof Underhill, is now and will in the future be a data resource (unique to South Africa) for Masters and Doctoral students, and for the range of potential users amongst environmental consultants, nature conservationists, government and other ornithologists.

[The CAR project] is a specific project, with a specific product. So, it doesn't really link with bird ringing or with the waterbird counts. But, at some point, a student will come along and use this as a basic resource for their PhD, their MSc. And that student would have to do all sorts of other fieldwork, like more regular counts, to see what the meaning of the twice-a-year counts is. So there would be a combination of fieldwork [and the use of existing resources in the ADU, such as] the CAR data, the Bird Atlas data, the data is available for each species, the water bird count system, the data available in the Bird Ringing Unit. (Les Underhill, interview)

Linkages, collaboration and dissemination

The ADU mission (quoted in Section 2.2) makes explicit reference to making an input into bird conservation, through research, monitoring and the dissemination of findings to relevant stakeholders. This emphasis is evident in the linkages, collaboration and dissemination activities of the ADU staff.

In the general course of their work, staff of the ADU interacts with a variety of stakeholders and potential users, such as government officials, and representatives from nature conservation agencies and other interest groups, many of who are also academics or scientists. Les Underhill sees these links as critical in order to prevent the Unit from operating as “an ivory tower”. In addition, as highlighted earlier, many of the bigger projects in the ADU depend for their success on the participation of large numbers of volunteers, many of whom are drawn from the stakeholder groups. The CAR project is exemplary in this case, utilising the services of over 700 volunteers from around the country. This is a unique mode of participation, given its scale and volunteer basis. Prof Underhill commented on some of the lessons learnt about interacting with stakeholders and potential users:

We learnt with the Atlas project, which was a big mass participation project, I think we learnt to communicate to, if you like, the man in the street, the interested citizen. I think that that skill has stood us in good stead, you know, dealing with everybody from that level upwards. We deal with academics and we deal with people in conservation research positions within the nature conservation departments and national parks. We deal with managers of nature reserves and people like that. You have to deal with all these people. One of the things that you learn is that just because you hold the title of professor doesn't mean that you can ride roughshod over people. You have to go in with some sort of humility. [] And I think one of the criteria on which I select staff is I don't select staff who are going to be cocky, arrogant, overconfident. I try and choose people who will relate to [] all the levels they need to relate to. (Les Underhill, interview)

The ADU staff disseminates their research findings in a variety of ways, including articles in scientific and popular journals, conference presentations and proceedings, meetings and presentations to stakeholder groups, and through media coverage. The ADU website is a reflection of the strong emphasis on dissemination of the research to potential users amongst ADU staff. The web site is packed with information about projects, activities and results and is updated on a weekly basis. There is detailed information on a number of different bird species, as well as Important Bird Areas, conservation initiatives and conservation agencies and organisations.

The various datasets are also made freely available to potential users. Prof Underhill described the Unit's approach as follows:

Our drive is to provide the data upon which conservation action can be based. There is a big gap between "data" and "action". Data has to be summarized and interpreted, and the implications extracted from it. Doing this properly is not always quick and easy. Too much conservation action is based on gut feeling and knee-jerk reactions. Too much conservation action is based on "off-the-cuff opinions" from the conservation "gurus", whom no one is prepared to challenge. (Personally, I don't believe any of the national [or international] gurus, and frequently make myself very unpopular!) We never cease to be amazed at the people who use our data, for a great variety of purposes, in all three of the fields you mention: consultants, conservation, research. We are trying to be increasingly free with our data; we enthusiastically endorse the GBIF [Global Biodiversity Information Facility] approach of making data as readily available as possible. (Les Underhill, e-mail, 28 July 2004)

However, Prof Underhill regards the Unit's role as ending at the point of producing scientifically-based findings, identifying trends and causal factors, and disseminating these in a variety of ways. Lobbying government to influence policy, or implementing programmes to change practice, are activities left to nature conservation agencies and the like:

We see a large part of our role as a service model, providing quantitative information to other people [] We can do the best job we possibly can; producing the Atlas, and producing the Important Bird Areas [] [But we need to] hand that information over to the next level, and they must actually run with that information, and actually use the well-researched facts to get action going on the ground. (Les Underhill, interview)

Funding

Financial support is received from UCT in the form of accommodation and computing facilities, as well as the salaries of Prof Les Underhill and Dr Marienne de Villiers, who is a part-time lecturer on a short-term contract. All other expenses, including the remaining salaries, are covered by commissioned research, sponsorships and donations and, occasionally, short-term contract work (such as conducting surveys and environmental impact assessments, or analysing data). The various funding sources include, amongst others, the national Department of Environmental Affairs & Tourism,

BirdLife South Africa, World Wildlife Fund⁷ South Africa, the Earthwatch Institute, and the African Eurasian Waterbird Agreement. The postgraduate students are funded in part via bursaries from the National Research Foundation. However, according to Prof Underhill, this funding is inadequate. Therefore, he does extra fundraising to top up the bursaries: “We aim to get full-time students to a minimum of R60 000 per year.” (Les Underhill, interview)

Prof Underhill reported that the funding of the ADU has always been a critical problem and that fundraising is the “toughest part” of his job. The problem is so acute that in recent editions of the magazine *Bird Numbers*, which is published by the ADU, a plea goes out to readers for donations or new membership subscriptions:

The Avian Demography Unit is still battling to keep on the financial straight and narrow. If your birding has been enriched by participation in the projects of the ADU, please consider making a donation. (Bird Numbers, Vol 11 No 1, July 2002, p4)

In the new South Africa, where there are enormous challenges in terms of broad and equitable socio-economic development, the ‘people issues’ have become paramount, often at the expense of environmental issues, and this is reflected in the relative paucity of research funds available for the latter. Another challenge for the ADU in terms of funding is that for most of the projects, insufficient time has passed for adequate data to be collected. This is the nature of ornithological data of this kind, in that only when substantial data has been collected (i.e. over a period of ten years or more), will the analyses and trends be meaningful.⁸ It is therefore difficult to demonstrate solid outcomes to potential funders, which poses a problem:

The University and the funding systems don’t want to actually start a research project that is only going to deliver meaningful results in ten years’ time. And most academics, in fact, wont tackle projects like that. (Les Underhill, interview)

According to Prof Underhill (Email, 28 July 2004), he and his colleagues have had to take a “high risk” approach to projects – launching them on a “shoestring” budget and only looking “for real support once they are up and running.” Prof Underhill also commented: “I am a risk-taker, and I am quite prepared to go out on a limb and follow my hunches and intuition” (E-mail, 28 July 2004).

⁷ Now known as the Worldwide Fund for Nature.

⁸ This issue is discussed in greater detail in Section 5.4.

Fortunately, as the years have passed and projects have been completed, these products have given the ADU a better footing with potential funders.

So for us, to a large measure, fundraising has been based on product, rather than on promise. I think that makes fundraising a whole lot easier. You can say, we've done all these various things. I think it makes it hugely easier to get funding. So when we were still doing the Bird Atlas, we had nothing to show for it. It's quite hard to ask people to back us or to back you on a promise that you're going to deliver something. Once you've got delivery under your belt, there's no doubt about it that fundraising becomes easier. (Les Underhill, interview)

The ADU receives relatively little funding from UCT. Prof Underhill felt strongly that the University did not recognise the publicity they gain through the press coverage of many of the ADU's projects, since they do not have structures in place that can translate "column centimetres" in the media into Rands (Email, 28 July 2004). He did concede, however, that this publicity does make it easier for the University fundraisers to raise money, which benefits the ADU in the end:

*If I had to complain about anything, I'd complain about the mismatch of publicity for the University compared with the resources we get from the University. I think we might be on the seventh or eighth article in the **Argus**, the **Cape Times** and **Die Burger** already this year, it's only March. Some of them are big articles. If the University was paying for that as advertising, it would be several times [more]. [] I think the University likes to see its name in the newspaper, but I don't think they actually put their money where their mouth is. But it's not a huge issue that causes me great grief at night. This is one of the things that I look at and get vaguely amused by, the mismatch between ... I occasionally point it out to the University hierarchy but they just grow tight and they say, you're doing a good job, thanks very much, but we're not going to give you any more money. But I guess, you know, all that sort of stuff in the newspaper makes it far easier for University fundraisers to actually go out and raise funds for the University. (Les Underhill, interview)*

These ongoing financial struggles pose a direct threat to the future sustainability of the Unit, as does the apparent lack of succession planning in terms of the Unit's management. Prof Underhill described his view on this as follows:

What will happen after I retire (I'm 57, but don't plan to retire until I have to, because I am enjoying my job too much) is anyone's guess. I'm trying to persuade my Head to allocate one of the many vacant posts in the Department of Statistical Sciences to a "Deputy Head". Alternatively, we could be "expropriated" by the government to become part of the new SANBI (South African National Biodiversity Institute)! Definitely, some lateral thinking is required. But I would very much like to see the spirit of the ADU continued. (Les Underhill, e-mail, 28 July 2004)

Despite these funding challenges, Prof Underhill reported that while the Unit could make money from the sale of data to other users, they prefer to make the data available free of charge so that it can be used to greater advantage. This highlights the general emphasis

among ADU staff on the importance of the broad dissemination and application of their research data and findings towards the further conservation of birds:

The database that comes out of the Bird Atlas project is now regarded as probably the best of its genre in the world. It's widely used by the world's top macro-ecologists and bio-geographers. It's the dataset of choice. I can even print you a list of Atlas papers, if you're interested, [things] which we would just never have dreamt of doing ourselves with that data. We really struggle with the concept of making our data available to researchers, as freely as possible, you know, people want to charge for data because it's hard won. But we've come to take the view that with the Bird Atlas data, it's out there and used by our colleagues and by our competitors better, because ultimately there's more kudos in repeated use of this dataset, than in us doing a few projects based on it ourselves. (Les Underhill, interview)

The features of the ADU as an organisational entity, as outlined above, have a direct bearing on the project that is the focus of this case study, namely the CAR project, which is described in detail below.

3 Overview of the Co-ordinated Avifaunal Roadcounts (CAR) project

3.1 Project initiation, objectives, research questions and potential value

The Co-ordinated Avifaunal Roadcounts (CAR) project was initiated in July 1993 by Mr David Allan,⁹ then a researcher at the ADU, as part of his Masters research, with the help of Ms Sue Mare and volunteers from the Cape Bird Club. According to Mrs Donella Young, co-ordinator of the CAR project, Mr Allan was concerned about the threatened status of numerous species of large terrestrial birds and the fact that they are not adequately conserved in protected areas. In addition, there was evidence of the importance of the private landowner in the conservation of these birds. The researchers described this development in the ***Eighth Annual CAR Report*** (2001:2) as follows:

Developed countries have appreciated for some time that the future of many species depends as much, or more, on privately owned land, and its management, as on formal nature reserves. In South Africa this is no less the case because so many bird species need to forage and range over large areas – much larger than most nature reserves – to survive. South Africa has only recently begun to make this paradigm shift, but the important role of the private landowner and, in particular, the farmer, is rapidly becoming clear. CAR helps to establish the link between privately owned land and nature conservation. Its long-term contribution will be in providing the scientific basis for the modification of land-management practices to ensure the survival of wild birds.

The CAR project, as initiated by David Allan in the Overberg region, functioned as a pilot study for what was to become an expanded and ongoing project of the ADU.

⁹ David Allan is now an ornithologist at the Durban Natural Science Museum.

The CAR objectives, as outlined in the CAR report (Young *et al* 2003:6) include the following:

- 1) Monitor the populations of appropriate large terrestrial species in diverse agricultural landscapes throughout the country, and produce annual indices of relative abundance that will highlight trends in their population status.
- 2) Collect data on habitat associations and age classes to provide greater insights into the biology and population dynamics of species.
- 3) Use results to formulate proposals on how landowners can modify land management practices to the advantage of sensitive and threatened species of wild birds.
- 4) Involve local communities in monitoring, thus promoting the conservation of 'their' birds.
- 5) Communicate CAR's findings to the broader community through scientific papers, reports, articles in popular media and presentations, as well as liaise with conservation agencies and lobbies to have the findings made known as widely as possible to landowners.
- 6) Provide information for relevant Environmental Impact Assessments.

These objectives might be seen to include different kinds of aims, from the advancement of scientific knowledge, to contributing to conservation policy and practice. For instance, one of the long-term aims of this data collection exercise is to enable the ADU to act as an "early warning of changes in the populations" of the bird species counted annually (Young *et al* 2003:6). In addition, it is hoped that the scientific recommendations made by the CAR team on land-management practices will help to ensure the survival of these birds in the long run. It should be noted, however, that the focus is not only on the conservation of these large terrestrial birds. There is a symbiotic relationship between these birds and the agricultural lands that they inhabit. According to Young *et al* (2003:6), these birds and other wildlife play an important role in agricultural pest control. The vision of this project is therefore much wider than the conservation of cranes, bustards and the like.

In order to meet the objectives identified above, the following research questions were formulated (Young *et al* 2003:6):

- 1) What large terrestrial birds occur in agricultural landscapes across the country?
- 2) Do summer and winter counts differ; if so, what does this tell us about the birds' behaviour?
- 3) What habitats are the birds using and do these differ from place to place?
- 4) Where are the strongholds of species, particularly the threatened species?
- 5) How are the populations in various areas changing over time and what are the possible causes?"

The CAR report outlines the potential value that the CAR project has to a number of constituencies:

Annual updates to governmental and non-governmental conservation agencies could include:

- *species densities, in summer and winter, for each precinct;*
- *population trend analyses for species per precinct;*
- *analysis of habitat use by species;*
- *details of re-sightings of ringed birds.*

CAR can independently assess the effectiveness of conservation initiatives, such as farmer and farm worker education programmes, and powerline modifications.

CAR can provide assessments of sensitivity required by environmental consultants for Environmental Impact Assessments of developments such as wind farms and powerlines.

CAR increases the awareness of large terrestrial birds and their needs in rural communities. In the long term CAR will be able to provide the scientific basis for bird-friendly land management practices. (Young et al 2003: 12-13)

3.2 The annual CAR project process

The CAR roadcounts are carried out twice a year – in mid-summer (January) and in mid-winter (July). This enables the researchers to detect any seasonal differences in the bird population distribution and habitat characteristics. Because these large terrestrial birds have extensive spatial requirements and move large distances, all CAR routes are counted on the same day to prevent double counting.

One of the CAR routes in the Eastern Cape



Photograph courtesy of the ADU

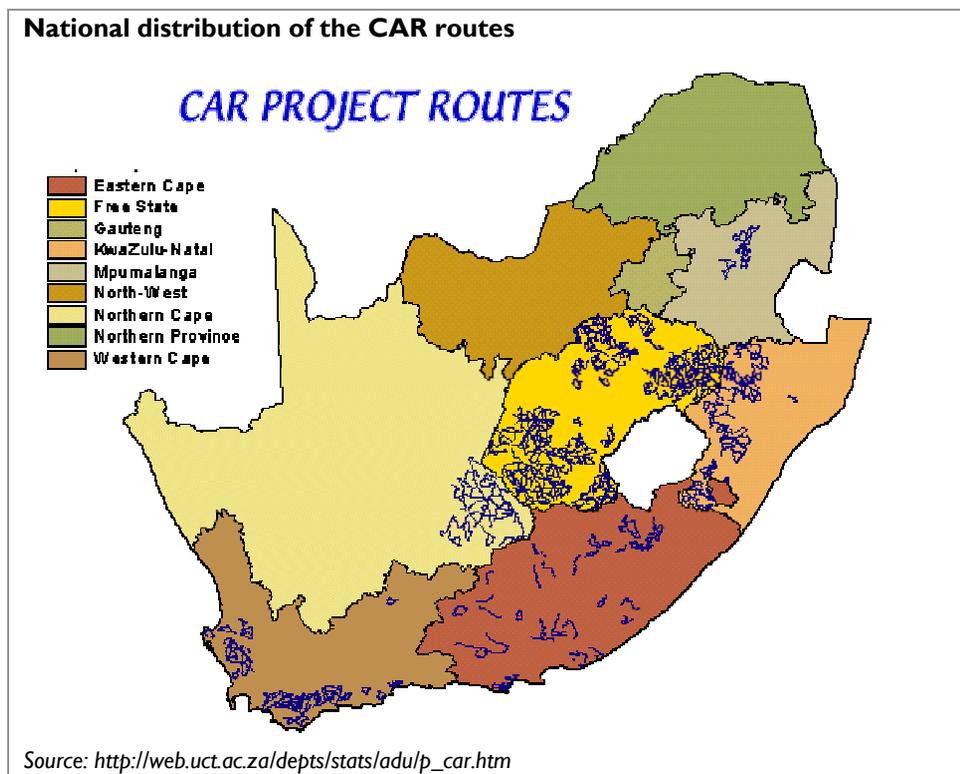
Between two and five observers cover each route, one of who is the route leader. Typically, the routes include public roads that pass through agricultural areas and are therefore often gravel roads. Routes range between 50-100km in length and are covered

in anywhere between three and five hours. Routes are recorded on 1:250 000 maps. They are also entered into a geographical information system for the purposes of mapping, and to enable the visual presentation of species' densities per quarter-degree grid cell. Routes within a particular area are clustered into 'precincts'. As far as possible, each precinct covers an area in which the topography, vegetation, type(s) of farming and bird community are relatively uniform. Each precinct is co-ordinated by a local Precinct Organiser. The map below shows the distribution of routes across South Africa in 2003.

Four **Information Sheets** are provided to volunteers. These include information on how to undertake the count; how to design new routes and modify existing ones; how to identify bustards¹⁰; and, how to fill out the roadcount form. The roadcount itself is described in the CAR report as follows:

Each route leader is supplied with a 1:250 000 topocadastral map indicating the route and farm numbers. Observers travel at 50 km per hour or less, and scan the landscape from the moving vehicle. If birds are spotted, observers stop to count and record them. In addition, every 2 km the observers stop, get out of the vehicle and scan the area carefully with binoculars. Details of numbers, age classes, habitat and, in the case of cranes and bustards, details of the birds' activity and the relevant farm number, are recorded on the roadcount form. [] As far as possible, the same observers are used to count the same route on every count, so that the counting method is consistent. (Young et al 2003:7)

¹⁰ It is necessary to provide additional information to volunteers on how to identify bustards because it is relatively easy to confuse Stanley's (or Denham's) Bustard with the Ludwig's Bustard. In addition, the distributions of these two species overlap in some parts of their ranges. The Information Sheets highlight the distinguishing features of these birds through a written description as well as diagrams of each species and their distribution. (E-mail, Donella Young, 27 July 2004)



The roadcount forms are collected and checked (for omissions or errors) by the Precinct Organisers. The forms are then sent on to Mrs Donella Young, who checks the completed forms again. Mrs Young described this part of the process as follows:

[The roadcount] forms come in by fax or quite often Precinct Organisers will gather them all together and then send it to me. But then I need to check whether there's anything missing. I must say email has been wonderful because if there are any queries I can get answers back fairly quickly. [] It takes about six to eight weeks for the data to come in. Then it's checked, it's captured and then I need to do a check after that for odd things. Then René runs a programme that puts it into those tables like in the newsletter. And then I try and write a fairly brief report about six to eight weeks after a count, which I put on the web site [] because I feel it's a long time from having done your counts on the last Saturday of January, it's a long time to wait until June, when you get your newsletter, because the newsletter goes out about five weeks before the winter count. [] I feel it's encouraging for people to read some of the highlights of the last count. (Donella Young, interview, 16 March 2004)

The roadcount forms are then captured in a Microsoft Access database. People employed on a part-time basis do the data capturing. For Mrs Young, it would be preferable to keep the same people over a longer term:

We've always employed somebody to do the data capture. Quite often it's been a student. We had somebody who had just written her matric who started all the data capture on all the projects. She worked here for her "gap" year before going to study conservation. And fortunately we have Linda Tsipa at the moment who, I hope, will be here on an ongoing basis because I found up until now, with each count, I normally need to teach somebody new to start the data capture. And it's not straightforward data capture. It's not just like figures. It does require quite a lot of input in starting somebody on it. [] I've found that having somebody who's familiar with the project really makes a huge difference. And that's one thing I would like for the project, is to have somebody who'd be on the project on an ongoing basis, because then I could delegate a bit more. (Donella Young, interview, 16 March 2004)

The data is analysed by the project co-ordinator. Query and summary outputs are run and the results are fed back to participants in newsletters and reports.

3.3 Stages in the development of the CAR project (1993–2003)

The CAR report (Young *et al* 2003:10-12) provides a detailed description of the history of the CAR project between June 1993 and March 2003. The core feature of the development of the project during this period was expansion – in the number of different species counted, and in the geographical spread of the roadcount routes. In the first two years of the project (June 1993 – March 1995), the focus of the counts was on the populations of Blue Crane and Stanley's Bustard in the Overberg region of the Western Cape. At the end of this phase, the project team assessed the feasibility of the project, and the reliability and usefulness of the results. According to Young *et al* (2003:10), the "project was refined and established as an ongoing monitoring exercise."

In the third year of the project (April 1995 – March 1996), CAR became a joint project of the ADU and BirdLife South Africa. The project also began to expand in scope. In the Overberg region, two new species were added to the count, namely the Secretarybird and the White Stork. New routes were identified in the Swartland region of the Western Cape. At the same time, initiatives to set up routes in KwaZulu-Natal and the Northern Cape were underway. With regard to the latter, Mr Mark Anderson, ornithologist for the Northern Cape Nature Conservation Services, initiated the Karoo Large Terrestrial Bird Survey in the De Aar district,¹¹ which includes the annual counts for the CAR project.

In the fourth year (April 1996 – March 1997), the first routes in KwaZulu-Natal were counted and efforts to set up routes in the Free State began. During this year, the project team decided, "the addition of further species would be done on a precinct-by-precinct basis depending on local conditions" (Young *et al* 2003:11). In addition, owing to the

¹¹ The Karoo Large Terrestrial Bird Survey is a joint project of the Platberg-Karoo Conservancy and the Northern Cape Nature Conservation Service, and is affiliated to CAR (CAR Eighth Annual Report, 2001, p4).

expansion of the project into other provinces, the need arose to appoint someone who would be dedicated to co-ordinating the project. Thus, the first CAR project co-ordinator, Ms Wendy Hitchcock, was appointed from June 1996 to early 1997.¹²

The fifth year of the CAR project (April 1997 – March 1998) saw a dramatic growth in the number of precincts and roadcount routes: the total distance covered doubled between the summer and winter roadcounts in 1997, from 4545 km to 9066 km. The first counts were conducted in the Free State and efforts to set up new routes in the Eastern Cape province began. Mrs Donella Young was appointed as the new CAR co-ordinator in October 1997. In March 1998, Donella visited areas within the Eastern Cape in order to introduce the CAR project to bird clubs, landowners and other interested members of the public. Owing to the establishment of new precincts around the country, the project team decided to increase the number of habitat categories.

In the sixth year (April 1998 – March 1999), the CAR project continued to grow in terms of the number of routes and the bird species counted. Counts took place for the first time on new routes in the Eastern Cape, KwaZulu-Natal and Mpumalanga, and routes in the Free State were extended. Changes took place in the roadcount form after feedback and discussion with participants and Precinct Organisers. Also in this year, links with other nature conservation organisations and interest groups, such as BirdLife South Africa, the South African Crane Working Group, and the Overberg Crane Group were strengthened. There was also considerable press coverage of the project in newspapers, and on radio and television.

In the seventh year (April 1999 – March 2000), the CAR project continued to grow, with the expansion of routes and the addition of new species in some regions. In May 1999, a CAR Working Group was formed, whose task it would be to provide input on “issues of method and management as they arose” (Young *et al* 2003:11). One of the outcomes of this group was the further refinement of the habitat categories in July 1999.

Other developments included the following:

Programmes were designed for producing summaries required for regular newsletters. Routes were plotted on 1:250 000 topocadastral maps, and these were captured in a geographical information system. About 80% of the data-capture backlog was cleared. Proposals for the eight-year CAR report were finalised. (Young et al 2003:11-12)

The eighth year of the CAR project (April 2000 – March 2001) saw further growth in the number of routes and some minor changes were made to the roadcount form. Donella Young and James Harrison (project manager) made presentations to environmental organisations, such as bird clubs, the South African Crane Working Group and the Overberg Crane Group, in the Eastern Cape, Western Cape and KwaZulu-Natal. The purpose of these presentations was to provide feedback to participants, and encourage

¹² Mrs Hitchcock took up a post in education at the National Botanical Institute at Kirstenbosch Gardens near Cape Town (CAR Eighth Annual Report, 2001, p3).

further participation in the project. During this year, progress was also made with the eight-year report.

The ninth year (April 2001 – March 2002) saw the first roadcount take place in the North West province. For the first time, two data requests were received: “one for an Environmental Impact Assessment for a proposed wind farm in the Swartland, and another from Eskom-Endangered Wildlife Trust Strategic Partnership for a proposed new powerline” (Young *et al* 2003:12). Further presentations were made to environmental organisations and bird clubs in KwaZulu-Natal and the Free State. Data analyses for the eight-year report were checked and corrected and the results were sent to the different authors.

In the tenth year of the CAR project (April 2002 – March 2003), most of the work revolved around the eight-year report, finalising individual chapters, writing introductions and conclusions, and doing editing and layout. On the project, some changes were made to one of the Information Sheets, an additional species was added to the count, and the project co-ordinator made presentations to various groups in KwaZulu-Natal to give feedback to participants.

The CAR report details the team’s plans for the five years following the report (Young *et al* 2003:13):

- a) Communicate the findings of this report through scientific and birding publications and the media
- b) Produce a sponsored leaflet highlighting the findings for the public and landowners
- c) Promote wider participation in the project and continue to visit regions to provide feedback and encouragement to participants and Precinct Organisers
- d) Develop more routes and precincts to extend the coverage of species and habitats
- e) Produce regular statistical updates and post them on the ADU web site, and
- f) Produce an updated comprehensive report in 2008.

Overall, the CAR project team is very satisfied with the rigour of the roadcount methodology, and the way in which the project has expanded over the years.

The method certainly seems to be effective. As the project spreads to other areas, we needed to expand things like habitat categories. But the method certainly we feel is quite well established now. (Donella Young, interview, 16 March 2004)

According to Mrs Young, however, some issues still need to be addressed. The first is to consolidate the geographic areas in which the project currently operates. Indeed, the map showing the spread of routes around South Africa in the CAR report (Young *et al* 2003:101; see also Section 3.2 above) highlights how clustered these routes are, with significant gaps in certain provinces. In addition, the CAR team would like to expand the coverage into provinces and regions where there are currently no routes, such as the Limpopo province, the succulent Karoo, and grassland areas, which are under threat from the development of plantations.

The second issue is that of funding which is discussed in detail in the following section.

3.4 Project funding

Core funding for the CAR project is provided by BirdLife South Africa, and the Tony & Lisette Lewis Foundation South Africa. Mazda Wildlife sponsored a copy of the report for each route. In addition, the CAR volunteers make a significant contribution to the project funding – according to the CAR report (Young *et al* 2003:8): “... volunteers indirectly contribute about R100 000 per annum in the form of transport, telephone and postage costs. For some who live far from their route, there are also accommodation costs.”

However, funding – or the lack thereof – is the most critical problem facing the project, and one that threatens its future sustainability:

We haven't managed to attract a specific sponsor for the project. The Tony and Lisette Lewis Foundation has been a very consistent funder. You know initially the project survived just really on core funding that was coming into the Unit and now we are trying to find a specific sponsor. [] But you know the budget is, well our budget for this year is R150 000 and so far we've got just over half of that. So quite a bit of my time at the moment, and towards the end of last year, has been trying to source funding. We have made quite a strong appeal to the bird clubs and certainly we've been amazed at the response from some of the smaller bird clubs. They really have been amazing. But it doesn't add up to a lot. I mean the bird clubs have contributed about R11 000 since we sent this report out and made quite a strong appeal to them. There are two or three private companies, where there's been a participant who's had contact in that company, and we've got about R25 000 in that way, which is encouraging. But we need a more specific sponsor, more ongoing as well. (Donella Young, interview, 16 March 2004)

The funding challenges experienced by the CAR project team reflect those of the Avian Demography Unit as a whole (see Section 2.2). For instance, a key factor relating to the funding of the CAR project is the relatively long period of time it takes to collect enough data of this kind for the results to be truly meaningful and useful.

The CAR report described the problem and made an appeal to potential sponsors as follows:

The value of the CAR project increases the longer it continues. It is unthinkable to stop counting now because much of the value of the earlier counts would be lost. The Common Birds Census in the United Kingdom has tracked population trends of more than 70 species for forty years, while the Christmas Bird Count, involving over 50 000 observers, has monitored trends of early-winter bird populations in North America since 1900! [] The future of CAR is in the balance because it has not been able to secure regular funding. It is hoped that this report will highlight the value of the information being collected on threatened species and encourage a sponsor(s) to commit to funding the project. A monitoring project of this nature needs to be continued in the long term to obtain meaningful results and therefore

requires ongoing support. In this report we have been able to demonstrate population trends in those precincts that have been running longest, e.g., the Overberg. The results from more recently established precincts will become more meaningful in a few years time. It is vital to continually monitor the status of threatened species so that conservation action can take place timeously. (Young et al 2003:12)

Mrs Donella Young also pointed out that another major challenge is that given the wide-ranging and critical 'people needs' in South Africa today, funding for environmental-type projects is often not a high priority:

I think companies are under a lot of pressure from a lot of people. I mean, we have approached Eskom for funding and Chris van Rooyen, who works for a partnership between EWT [Endangered Wildlife Trust] and Eskom, does a lot of their environmental impact assessments for powerlines. He phoned me quite soon after the report came out and said they're using this report extensively in his environmental impact assessments, and he hoped that we might be able to get some funding from Eskom, but they're still considering it. But when I spoke to the person who Chris referred to me, he said "We just get so many appeals from different people". (Donella Young, interview, 16 March 2004)

One of the strategies that the CAR team is exploring is getting more schools involved since, according to Mrs Donella Young, as far as funding is concerned "there seems to be more interest amongst potential funders in projects involving the youth and people rather than birds themselves" (E-mail, 27 July 2004). Mrs Young highlighted some of the developments in this regard:

I'm actually trying to encourage participants to approach schools in their local area. I really feel it's an activity which particularly high school children would enjoy. It's not a huge commitment. It's only two Saturdays a year. And they really have a very, I think, enjoyable experience of collecting information in a scientific way. There's a teacher up at a school in the Eastern Cape and I got a lovely letter from him at the end of last year. He takes a kombi load of children to his farm, initially for breakfast, or sometimes apparently they camp overnight, and then he takes them out for the day. And they do their route and they count regularly. He sent me some photographs and it's obviously a wonderful experience for these children and he says they really try and spend some time on the farm, before returning to reality at school. [] And we started a shorter route for primary schools in the Overberg, Teslaarsdal, a tiny little village. And the headmaster there has been really fantastic and taken a group of four to five children, his Grade 7s. We made it shorter because a normal route takes about four or five hours to do, and that's too long for primary school children. (Donella Young, interview, 16 March 2004)

3.5 The CAR project team

The ADU staff and postgraduate students

Mr James Harrison¹³ is the project manager and editor for the CAR project. As such, he manages the running of the CAR project, and is responsible for guiding all policy and planning decisions, such as whether to add a particular species or introduce a new route. Mr Harrison also edits all the project reports and newsletters.

Mrs Donella Young¹⁴, the CAR co-ordinator, is responsible for the overall co-ordination and day-to-day running of the project. Mrs Young interacts closely with the Precinct Organisers and, where possible, engages with the volunteers in order to keep them motivated and informed. Mrs Young also compiles the CAR newsletters, and undertakes the analysis of the data and the production of the summary tables and graphs. More recently, Mrs Young has been involved in fundraising for the project. Both Mr Harrison and Mrs Young play a key role in disseminating information and engaging with volunteers and other stakeholders through presentations and newsletters.

Mr René Navarro undertakes all the information technology and data management tasks in the Avian Demography Unit. Within the CAR project, he is involved in database design, data processing and the production of graphics.¹⁵ Three 'gap-year' students, one undergraduate student, one postgraduate student and two ADU employees have been involved in data capture for the project at different times. All the desktop publishing is done by the ADU and a volunteer assisted with cartography. To date, no postgraduate students have used the CAR data (except for Mr David Allan who initiated the project) towards their degrees.

The volunteers

It almost goes without saying that without the hundreds of volunteers who undertake the roadcounts twice a year; the CAR project simply would not be possible. In addition, the Precinct Organisers have the important task of organising and ensuring the smooth running of the roadcounts in a particular cluster of routes, or 'precinct'. Each Precinct Organiser co-ordinates between four and ten routes. They are also the first line of communication the CAR Co-ordinator has with the volunteers who undertake the roadcounts.

¹³ James Harrison has an MSc degree in Nature Conservation. He co-ordinated the Bird Atlas project from the time it was transferred to the ADU in 1986, and is the Manager of the Birds in Reserves Project and the Southern African Frog Atlas Project. James was one of the founders of the Avian Demography Unit. (James Harrison, personal communication)

¹⁴ Donella Young has a Masters degree and has worked in research for twelve years. She was a biology teacher and worked in the Department of Zoology at the University of Cape Town before taking up her current position in the ADU.

¹⁵ Donella Young said of René Navarro that owing to his background in biology, he has an innate understanding of how to manage and present data, and in particular, in solving problems related to presenting data visually, in a way that is accessible and comprehensible to laypeople. (Donella Young, personal communication, 1 September 2004).

Principal and Grade 7 learners from the Teslaarsdal Primary School on a CAR count



Photograph courtesy of Chris Young

Volunteers at the ten-year celebration of roadcounts in the Overberg region



Photograph courtesy of Wicus Leeuwner

Two Precinct Organisers, who both happen to be ornithologists, play a more significant role in the CAR projects than others do. They are Mr Mark Anderson of the Northern Cape Department of Agriculture, Land Reform, Environment & Conservation¹⁶; and Mr Brian Colahan of the Free State Department of Tourism, Environment & Economic Affairs. Each of these individuals co-ordinates routes and implementation of the CAR project on a much larger scale than elsewhere and, according to Mrs Young, make valuable contributions to the project. They were also both co-editors of the report.

Through the involvement of all these individuals, and their own networks of colleagues, other organisations play a critical role in the ADU's ability to carry out the CAR project, and these are outlined in brief below.

¹⁶ Now known as the Northern Cape Department of Tourism, Environment and Conservation (Mrs Donella Young, personal communication, 1 September 2004).

Other stakeholders

In early 1999, a CAR Working Group was established which comprises the project management and representatives from landowners, nature conservation organisations and other organisations involved in the project. The Working Group is consulted around issues to do with modifications to the scope or methods of the project. The CAR project team also maintains linkages with a number of other organisations involved in the conservation of large terrestrial birds. According to the CAR report (Young *et al* 2003:9), “Exchange of information is facilitated and collaboration leads to more effective conservation.” Examples of these organisations include: the Overberg Crane Group; the South African Crane Working Group; BirdLife South Africa’s Important Bird Area Conservation Programme; and the Percy FitzPatrick Institute at UCT.

4 Mode of knowledge production

4.1 The nature of the research and the research process

The CAR project is essentially a monitoring or survey project which involves the collection of data on a number of terrestrial bird species, using the ‘roadcount’ methodology (see below). The data is analysed statistically in order to identify population trends in terms of numbers, distribution, habitat use and breeding. Comparisons are made between the summer and winter counts and, in those cases where sufficient data is available, comparisons are made between areas and between the different species occurring on different habitats (Donella Young, e-mail, 27 July 2004). The CAR project is a form of ‘strategic’ research insofar as the researchers believe that the data generated will be useful in a variety of contexts and applications. The CAR project is interdisciplinary insofar as it draws on expertise within the Agricultural Sciences, the Biological Sciences and the Environmental Sciences, while the analyses are purely statistical in nature.

An important feature of the project is the extent to which it depends on the goodwill and dedication of a large number of volunteers. The opening pages of the CAR report bear testament to the broad participation of a diverse range of individuals and organisations in the CAR project. No less than thirty-eight authors contributed to the report. Sixty-four participating organisations are acknowledged, ranging from local bird clubs and schools, to nature conservation agencies, government departments and Eskom. The most impressive numbers, however, are those of the volunteers – approximately 750 people, about half of who are farmers – who undertake the roadcounts. In the interview, Mrs Young emphasised time and again that the success of the CAR project rests on this team effort.

As was highlighted above, the CAR project interacts closely with the Northern Cape Department of Tourism, Environment and Conservation, and the Free State Department of Tourism, Environment and Economic Affairs. According to Mr Harrison, these are “strong collaborative links”, without which the CAR project could not have developed precincts in these provinces. There is something of a symbiotic relationship between the CAR team and these provincial government departments; Mr Harrison explained that while Mr Mark Anderson (Northern Cape) and Mr Brian Colahan (Free State) effectively “do work for the CAR project”, the project, in turn, provides information to these individuals for use in their own work (James Harrison, personal communication, 1 September 2004).

The description of the CAR project between 1993 and 2003 provided in Section 3.3 above highlighted the manner in which the research process has undergone continual refinements, adjustments and expansion through the years. For instance, the procedures and background information for data collection, as well as the species and habitat categories have been refined over time. In addition, the project has expanded in terms of its geographical scope, and the number of species and routes covered. In some cases, adjustments have been made to the roadcount form in order to incorporate the requirements of similar or parallel projects, as was the case in the Northern Cape with the Karoo Large Terrestrial Bird Survey.

A unique feature of the CAR research process is that it involves or gives rise to what might be termed ‘amateur scientists’ – particularly the volunteers who participate in the roadcounts, and who are drawn from many walks of life. Through participation in the CAR project, these individuals are exposed to the ‘scientific method’ and engage, to some extent or another, in the ‘scientific results’ of the project. More importantly, however, some of these volunteers have had the opportunity to engage more deeply with the research process. For instance, volunteers have provided feedback on the roadcount form in terms of its application in the field, which has resulted in adjustments to the content or structure of the form. In addition, a number of participants have contributed to reports and other project documentation that has been widely disseminated. Mr James Harrison (personal communication, 1 September 2004) used the term “citizen science” to describe this level of participation in the research process on the part of volunteers, and observed that it is a concept that is quite widely recognised as being valuable to scientific research insofar as it involves the public, and therefore has the potential for a wider impact. Mr Harrison suggested that the Avian Demography Unit as a whole occupies a unique niche in this regard (that is, their involvement in so-called “citizen science”) and that it is part of the Unit’s corporate identity to try and create “a bridge between academe and society at large”.¹⁷

The CAR project is based on a very specific methodology, one that is quite unique to the world of ornithology, and this is described in the following section.

4.2 The ‘roadcount’ method

A unique feature of the CAR research process is the ‘roadcount’ method that it employs. Roadcounts have a long history internationally and in South Africa. One of the first South African roadcounts appears to have been made on birds of prey by Rudebeck in 1950-51 (*Bird Numbers*, Vol 7 No 2, August 1998). Early roadcounts of cranes were conducted by Roy Siegfried in the Western Cape (1965-66) and Carl Vernon in the Eastern Cape (1977-87) (Young & Harrison 2000:62-63).

The CAR project employs the roadcount method because these large-bodied terrestrial birds inhabit very widespread geographical areas, most often agricultural lands, and are therefore conspicuous and easily spotted. As Mrs Young commented, the roadcount

¹⁷ One example of this is the “semi-formal” journal *Bird Numbers*, which is published by the ADU. According to James, the publication makes space for contributions by birders (i.e. non-academic contributions) and is written in a fairly simple and accessible style (James Harrison, personal communication, 1 September 2004).

method “has proved very effective in agricultural lands, especially areas like the Overberg where it’s more open and so you can see for vast distances, but it wouldn’t work so effectively in forest areas” (Donella Young, interview, 16 March 2004). In addition, the uses of motor vehicles in undertaking the counts is necessary in order for volunteers to cover large distances in a short space of time.

According to researchers on the project, the CAR roadcounts constitute a standardised methodology for counting birds, which has proved to be highly effective in establishing a measure of “relative abundance” of a population of birds (Young *et al* 2003:6). However, the continuous expansion of the project, in terms of the number of routes and species covered, has posed some challenges for the project team in terms of the statistical analysis of the data. The expansion of the project over time has led to the following problems (Young *et al* 2003:9):

- ◀ Different monitoring periods as the project spread to new areas and new precincts were established
- ◀ Different monitoring periods for different species resulting from the addition of species at various times, and
- ◀ Route length variation owing to variation between vehicle odometers, and occasional unforeseen circumstances arising on particular routes during counts.

In addition, the data for very small precincts, and precincts for which there is a relatively short time-span of data collection, are not regarded as being particularly robust.

4.3 Project outputs and dissemination strategies

In line with the general approach of the ADU, the CAR project team puts considerable effort into providing feedback and disseminating findings to project participants, external stakeholders, potential users and other academics in the field. This is done via regular newsletters, the web site, meetings and presentations, conference papers, and articles in scientific and popular journals.

Some of the key dissemination efforts and target audiences include the following:

- ◀ Landowners, particularly farmers, are provided with feedback concerning the population trends for the birds on their lands. In addition, they are given guidelines to encourage the conservation of these birds
- ◀ Regular report backs on trends in numbers and use of habitat in cranes are given to the South African Crane Working Group and the Overberg Crane Group
- ◀ Monitoring information is disseminated to provincial conservation departments, and
- ◀ Information from the CAR project has been provided to bird tourism groups in the Overberg and the Swartland.

One of the primary outputs thus far is the eight-year CAR report (Young *et al* 2003). The CAR report details the findings of eight years of roadcounts by each precinct, and by each species. Three sets of recommendations – for landowners, for conservationists, and for the CAR team – are clearly formulated and presented early on in the report in a section entitled “Big Birds on Farms: The Message”. (See Appendix I for the summarised list of

recommendations.) In addition, within each precinct and species account, more specific recommendations are offered:

For each species account there's a section "Conservation status and advice to landowners". And then each precinct account has got a similar section: "Large terrestrials in the precinct and advice to landowners", and that is fairly broad general recommendations. In the long term, because we are recording habitat, whenever anybody counts or sees a bird, they record the number of birds but they also work out which habitat it's in. And they're also asked to note if there's something nearby that the birds may have been attracted to. And in the long term, we feel we may be able to use that habitat information to formulate more specific proposals about conservation. (Donella Young, interview, 16 March 2004)

A copy of the report has been distributed to all the farmers and the nature conservation agencies that have participated in the project. The CAR Co-ordinator intends to identify additional conservation agencies to which she can send the report. The CAR project team is also thinking about compiling a pamphlet which will synthesise the main findings of the report, and which would be targeted primarily at landowners in general.

It's something James and I have put on our agenda to start looking at this year, and for next year when we have the meeting at the beginning of the year, is to develop a pamphlet that would be probably an A5 size, and fifteen to twenty pages long, that would synthesise quite a bit that's come out of the report, and possibly what's come out since then, you know we would update the information. But that would be specifically geared towards providing feedback for landowners. (Donella Young, interview, 16 March 2004)

The CAR Working Group suggested that the team runs a series on the CAR project in farming magazines such as the **Farmers' Weekly** or **Landbou Weekblad**, which might preclude the need for a pamphlet.

Thus far, only one article and one review have been published in peer-reviewed scientific journals.¹⁸ Another article, based on the White Stork data, is currently in preparation by one of the post-doctoral students in the ADU, Dr Aeshita Mukherjee. The project team would like to see more scientific papers coming out of the project; however, this will depend on the collection of a 'critical mass' of data for other precincts.

Project staff has also published around 46 articles in popular journals, such as **Bird Numbers** and **African Wildlife**, as well as six conference papers. (See Appendix 2 for the list of articles, conference papers and internal publications associated with the CAR project.) Project staff have made 30 presentations to stakeholders, held 12 meetings with potential users, and provided technical assistance to potential users on a number of occasions. One of the most striking features of the CAR project documents is the easy

¹⁸ These include: Allan DG (1994) 'The abundance and movements of Ludwig's Bustard *Neotis ludwigii*.' *Ostrich*, 65:95-105; Van Rooyen C (2004) 'Review of Young DJ, Harrison JA, Navarro RA, Anderson MD & Colahan BD (eds) 2003. *Big Birds on Farms: Mazda CAR Report 1993-2001*. Avian Demography Unit, Cape Town.' *Ibis* 146: 183.

and accessible style in which they are written. An excerpt from the newsletters is reproduced in box 1.

Box 1: Excerpts from the CAR winter 2002 count newsletter on the ADU web site (written by Donella Young)

Dear intrepid CAR observers,
I just wanted to thank you all so much for braving the wild, wintry weather to do your CAR count at the end of last month. I was very concerned the week prior to the count, as there were snowfalls in the Barkly East and Elliot areas and one cold front after another was passing through Cape Town. I woke in the early hours of the 27th to a huge storm, however thankfully the worst was past by dawn. I know there were strong winds in many parts of the Western Cape, Eastern Cape, Karoo and Free State. [] I know some rather muddy, chilly people and cars must have returned home rather later than usual. I have included some pictures from the Barkly East Reporter of the road conditions encountered by Kevin Meise on his count, as well as some unusual pictures of Crowned Cranes and a Secretarybird in the snow.

Finally, the CAR web page¹⁹ is an important form of broad dissemination and a point of access for interested individuals to download the relevant Information Sheets or the CAR newsletter. The team is planning to include a section on annual trend updates in the near future.

It is clear from the above that the CAR research outputs are primarily targeted at potential users outside of the traditional university context. This is largely because of the underlying intention of the CAR project to inform and influence conservation and land-use policy and practice. It should be noted, however, that many of these stakeholders – and particularly those who work in nature conservation agencies or as environmental consultants – are researchers, academics or scientists (e.g. ornithologists) in their own right.

5 Mode of knowledge utilisation

5.1 The intended users and beneficiaries of the CAR project

The explicit model for knowledge use apparent in the CAR project is that of broad dissemination of data and findings to potential users. This is very much along the lines of the approach within the Avian Demography Unit as a whole, where the emphasis is on generating information that is relevant to and can support planning and management within nature conservation (strategic research), but does not undertake this work for specific clients (applied research).

Academics and researchers in ornithological or environmental fields are among the potential users of the CAR project data and findings. The primary emphasis, however, appears to be dissemination to individuals and organisations outside of the academic context. Potential users here include landowners (commercial farmers); companies like Eskom and environmental consultants (with regard to changes in land use of

¹⁹ http://web.uct.ac.za/depts/stats/adu/p_car.htm.

development, and for environmental impact assessments); nature conservation agencies; provincial environment and tourism departments; and, other interest groups such as bird clubs and schools. For this kind of dissemination, the CAR project team plays an important role in analysing and interpreting the data in order to convert into knowledge, and from there to generate relevant messages for potential users (James Harrison, personal communication, 1 September 2004).

Box 2: The Overberg Crane Group

The Overberg Crane Group is an informal partnership between the Overberg farming community and Cape Nature Conservation. The Overberg region is divided into four parts: Caledon, Bredasdorp, Swellendam and Swartland area. One farmer and one representative from Nature Conservation are selected from each of the areas and together they form the Steering Committee. The Group's focus is on the conservation of the Cranes in the region and, according to Wicus Leeuwner, "to address the problems that farmers have with cranes, and the cranes have with farmers". The Group co-ordinates the annual Crane Census during which each landowner counts the Cranes on his or her farm. As an awareness programme, the Crane Census does not have a scientific basis, but it does draw on the CAR data for the region to help farmers to do their counts.

Source: Interview with Wicus Leeuwner

A number of agencies or organisations that participate in or are associated with the CAR project also play a role in the dissemination of the findings to other stakeholders and users, with a particular focus on raising awareness about the importance of the birds and the trends in their numbers and distribution. A good example is the Overberg Crane Group that disseminates information obtained from the annual CAR progress reports to farmers (landowners), farm workers and farm children (in rural schools), via meetings and slide show presentations. The Group also runs workshops in the area with farm workers, to raise awareness about the importance of birds on farms, the need to protect wetlands and to be more responsible about the use of poisons. Mr Wicus Leeuwner, Chairperson of the Group, described their approach as follows:

In the Overberg Crane Group we use the results a lot. We use the results to give feedback to people [the landowners/farmers] and to make them aware of the Cranes and what's happening in our area. We will tell them that there seems to be an increase in the area and this is the number of birds involved. We give them ownership of the birds through that.
(Wicus Leeuwner, interview)

In this sense, some interest groups or conservation agencies are both users of research, as well as intermediaries in the dissemination and further utilisation of the research findings.

5.2 Examples of utilisation

As has been highlighted on a number of occasions in this report, the findings are widely distributed to targeted stakeholders. In addition, more recently there have been direct requests for data and information from conservation agencies and environmental consultants. The CAR project team is therefore aware of at least some

instances where the data or findings have been taken up and used to inform policy or practice in various contexts, some of which are discussed in greater detail below. Overall, however, the project team does not have any way of assessing the impact of their information dissemination to potential users. Donella Young suggested that there is at least a high potential for use among the farmers who participate in the counts, since most of them already have a real concern for and commitment to conservation issues. The assumption appears to be that the strong commitment on the part of the farmers means there is a strong likelihood that they are in fact engaging with and applying the recommendations of the research. The same applies to those representatives from nature conservation agencies and provincial government departments who participate directly in the roadcounts.

I think, you know, the fact that half the counts are done by farmers perhaps indicates that it is something that they feel is important and that they are committed to. And farmers are very busy people and they are doing it on Saturday, which is their own time. So I think the fact that they have remained involved perhaps indicates that it is important to them. And in our newsletters and the information sheets, I try to encourage a positive attitude towards conservation. [] I have a farmer on the CAR Working Group as well, and I mean certainly he asks quite difficult questions sometimes [laughs], in that he's obviously processing a lot of what is coming back. And I've sent data to him as well, which he's asked about, because he's obviously thinking about it and engaging with it. (Donella Young, interview, 16 March 2004)

Staff go out and they talk to farmers' groups and bird clubs, if they get the opportunity to get out there they will talk about it. And in doing so they, there's a feedback loop in which you get people to participate in the projects. And once people are participating in the projects they tend to behave more responsibly. A project like CAR, a large proportion of the data is actually collected by farmers, which is quite amazing really. And that must feed back into the way they actually operate on the land they own. One hopes that we are having a positive impact there. (Les Underhill, interview)

These assumptions on the part of the project team do appear to be borne out to some degree in reality.

It should also be noted that unlike the research in the Avian Demography Unit as a whole, the CAR project has thus far not had the luxury of having any postgraduate students using the data, in order to answer some of the 'why' questions that emerge through the trend analyses. This is mainly because of insufficient data and time series for most of the precincts covered in the CAR counts (the exception being the Overberg region which now has more than ten years of data collected). This issue and the implications for utilisation are discussed in detail in Section 5.4.

The remainder of this section is dedicated to detailing specific examples of utilisation, namely with regard to changes in farming practices on the part of the commercial landowners, the use of data and findings to inform bird impact assessments for

environmental planning, and the use of bird-related information for the development of ecotourism activities.

Changes in farming practices

According to Wicus Leeuwner – one of the farmers involved in the CAR roadcounts, and Chairperson of one of the users of the CAR results, the Overberg Crane Group – while farmers are unlikely to make major changes to their farming practices, they have begun to respond in small, but important ways to the information they receive:

Farmers won't [change their farming practices to suit the birds] on a macro scale. In other words, farmers are not going to plant different crops to accommodate cranes. But they definitely manage the crops or their farm practices around the crops that they do plant, are definitely influenced by the cranes. That is because we were able to create awareness through the media, through a lot of things. But the farmers became aware of the cranes, and they became aware of the problems experienced with the cranes. [] [For example] with sheep farming it is very easy because the sheep are found on dry-land pastures, and there are certain practices around the sheep that influence the cranes. The sheep, for instance, are being fed hay that is in bales tied with twine. And if that twine is left lying in the veld then it will get caught around the birds' legs. (Wicus Leeuwner, interview)

To solve this problem, the farmers ensure that this twine is picked up from the veld once the hay bales have been untied. Another example is that farmers have learnt to erect small fences around their feed troughs to prevent any damage caused by Cranes and other large birds.

According to Mr Leeuwner, there has been an enormous buy-in by the farmers over the years. The founder of the Overberg Crane Group, Ms Ann Scott, played an important role in this regard as she encouraged the formation of a partnership between the community and the local Nature Conservation. The CAR project, according to Mr Leeuwner, has strengthened this commitment as it promotes ongoing awareness of the birds on the farms, and provides a scientific basis for information:

The community definitely bought into this whole thing by identifying with the cranes and making them one of the symbols of the Overberg. And the CAR count did a lot to help that because it helped in creating awareness for these birds. Because you can tell a farmer that this has happened to the number of cranes in his area, and then he is immediately interested. It gave a scientific base to our own observations, you see, because they say that farmers are good in two things: they are known to be really keen observers; but it is also known that they take those keen observations and come to the completely wrong conclusions! (Wicus Leeuwner, interview)

Environmental planning

In addition to the broad dissemination of findings to external stakeholders, increasingly environmental consultants and conservation organisations approach the CAR project team with requests for information or data from the CAR project.

Recent examples include environmental or bird impact assessments for the following:

- ◁ The siting of a wind farm in the Swartland district
- ◁ The routing of powerlines by Eskom, and
- ◁ The identification of important bird habitat for the Ekgangala Grassland Trust.

Two of the above examples are discussed in detail below.

Mr Chris van Rooyen,²⁰ Programme Manager of the Eskom-Endangered Wildlife Trust (EWT) Strategic Partnership, regularly consults the results reported in the CAR eight-year report,²¹ together with other data available from the ADU, when undertaking bird impact assessments for Eskom's plans to lay powerlines.²² Mr van Rooyen described how he uses the CAR report as follows:

Depending on where the lines go, I would get hold of the CAR data for that area, if there are any transects or whatever they call them here, and then I would use that to get an idea of what species occur there and their reporting rates. [] For example, if we've identified Blue Cranes in a particular area as a powerline-sensitive species that occurs there, based on for example the Bird Atlas; we know it occurs there. But now you try to refine it a little bit more and that's where the CAR report is very handy because it actually tells you in what sort of vegetation they're found. That's typically the way in which we'd use it. We'd say there's a reporting rate of x y z for these birds, in the CAR transect, so you're likely to find that these habitats are of a higher risk or a lower risk. (Chris van Rooyen, interview)

²⁰ Mr van Rooyen has a BA LLB degree and has been practising as an environmental consultant for the last seven years.

²¹ Young *et al* (2003) *Big Birds on Farms: Mazda CAR Report 1993-2001*. Cape Town: Avian Demography Unit, University of Cape Town

²² According to Mr van Rooyen, about 50% of the work undertaken in the Eskom-EWT Partnership is applied research. Mr van Rooyen puts in proposals for research to Eskom, based on his ongoing experience in the field, and problems he identifies. If Eskom provides the funding, he will either undertake the research himself, or sub-contract it to researchers within universities. Consulting data sources such as the CAR report is therefore one of a number of their research activities. [Chris van Rooyen, interview]

Box 3: The Eskom-EWT Strategic Partnership

The five-year Strategic Partnership between Eskom and the Endangered Wildlife Trust commenced in 1996. The primary goal and expected outcomes of the Partnership are described on the WildNet Africa web site as follows: "... to establish an integrated management system for the management of wildlife interactions with electricity structures. Ultimately, the outcome will be a safer environment for some of our most threatened and vulnerable birds such as the blue crane, wattled crane, crowned crane, cape griffon, martial eagle, Ludwig's-, Stanley- and kori bustard as well as the white stork. Rural customers will benefit through a more reliable electricity supply because less wildlife-related interruptions will occur." The key activities of the Trust at present include:

- Defining key conservation sites for all three species of cranes with a view to future proactive marking of lines
- Gaining insight into the problem of terrestrial birds colliding with powerlines
- Testing and refining various mitigation devices for use on electricity structures
- Designing and developing a web site to facilitate worldwide networking on this problem, and
- Closer networking with agricultural and conservation bodies.

Source: <http://www.wildnetafrica.co.za/wildlifearticles/ewtvision/1996/eskompnership.html>

The Eskom-EWT Partnership is a partner (with Northern Cape Nature Conservation Services) in the Karoo Large Terrestrial Bird Powerline Project, and is involved in the National Crane Census.

Source: <http://www.eskom.co.za/enviroreport99/bird.htm>

According to Mr van Rooyen, it is seldom the case that Eskom will change its plans significantly, based on the results and recommendations of his bird impact assessments. They will, however, take into consideration where to place their "mitigation devices"; that is, structures incorporated into the powerline which prevent damage to "powerline-sensitive" birds:

It would not so much impact on where [Eskom] put their line. It would, in extreme cases, yes it would, you could maybe have a deviation or a bend or a slight change in the route. More importantly, it will impact where they are likely to put the mitigation devices when they build it. [A mitigation device is] something like a bird flapper, which is an anti-collision device, or having specific types of structures used [to prevent birds from getting] electrocuted. (Chris van Rooyen, interview)

Mr van Rooyen effectively uses the CAR data and findings to argue for a particular conservation position or approach to Eskom, in his position as a consultant.

The second example of utilisation for environmental planning is the use of the CAR raw data by Anthony Emery²³ of Emross Consulting (Pty) Ltd,²⁴ on behalf of the Ekangala

²³ Anthony Emery has a Masters degree. He first came into contact with the ADU when he was a postgraduate student at the University of Cape Town. Prior to becoming an environmental consultant, Mr Emery worked for Mpumalanga Nature Conservation.

²⁴ Emross Consulting (Pty) Ltd is an environmental consultancy based in White River, Mpumalanga.

Grassland Trust. The Trust was involved in identifying approximately 1.7 million hectares of grassland as areas of conservation importance, in the region where the Mpumalanga, Free State and KwaZulu-Natal provinces border. Mr Emery was involved in modelling the species distributions in known localities and from that, identifying important grassland conservation areas using the “systematic conservation planning” approach. To do this, Mr Emery analysed selected variables from the CAR dataset, including the important species that were identified, total counts, and whether there were chicks present, since this indicates whether breeding is taking place. Mr Emery explained the process as follows:

Then using that to identify that that site was either going to be used for foraging, or that breeding was taking place near or at that site, and then using that data to predict the distributions of particular species. [] from that I could create distribution maps for each species. And then what the conservation planning analysis does is it identifies areas of occurrence of species, and then uses an iterative approach to select sites with the suite of species which one wants to conserve within specific targets. It allows one to start selecting important conservation areas. (Anthony Emery, interview)

Box 4: The Ekangala Grassland Trust

The Ekangala Grassland Trust was established in March 2000. It is the vision of the Trust that all communities use and manage the components of the grassland biome within the biosphere reserve sustainably. Their mission is to contribute towards the sustainable existence and ecological integrity of the grassland biome in South Africa through the establishment and maintenance of an effective biosphere reserve in the high altitude (>1700 m) moist grasslands of KwaZulu-Natal, Mpumalanga and the Free State. The Trust’s main responsibilities include:

- Promoting proactive and integrated land use management
- Applying appropriate 'conservation tools' according to priorities based on biodiversity criteria and opportunities as and when they arise, and
- Aiming at acquiring key pieces of land as well as persuading landowners to apply sustainable land management practices.

Current progress is described as follows on the KwaZulu-Natal Wildlife web site: “The first iteration of the Ekangala Systematic Conservation Plan has been completed. Conservation targets were set for 40 endemic and/or endangered species, 59 vegetation communities and several ecological processes. The minimum set of currently untransformed areas required to meet all conservation targets simultaneously were identified. This plan will become an invaluable resource to guide and prioritise the activities of the project coordinator, and the information will be fed into the Municipal Integrated Development Plans and Land Use Management Systems in order to ensure sustainable development.”

Source: <http://www.kznwildlife.com/>

It is interesting to note that in each of these examples, the consultants drew on different forms of research output – Mr Chris van Rooyen consulted the graphs and tables in the CAR report, while Mr Anthony Emery conducted new analyses on the raw data. In addition, both consultants reported that they draw on a range of other data available at the ADU in the course of their work. In both cases it appears that the specific value of the CAR data was that it provided a finer level of detail than other datasets, such as the Bird

Atlas data. For example, Mr van Rooyen reported that the Bird Atlas data is always his first port of call for a study. He will then consult more specific or local data sources, such as the CAR data from the ADU, but also data available from local ornithologists, bird clubs and nature conservation agencies. It is in this sense that the logic of the “repository”, which applies to much of the ongoing research in the ADU, is evident in the CAR project.

Ecotourism activities

Ecotourism – that is, making exposure to and participation in the natural environment a tourist activity – is a growing trend in South Africa and around the world. There is evidence that farmers in the Western Cape are using CAR data to inform the development of their own ecotourism initiatives.

Box 5: The Open Africa project

Open Africa is a registered not-for-profit organisation under the patronage of Nelson Mandela and headed by the founder, Noel de Villiers. It was established in 1995 with the aim of optimising the synergies between tourism, job creation and conservation. It does this by inviting interested parties to set up tourism routes, across the African continent, which they do via the Open Africa web site. Existing routes include, amongst others, the Whale Route at the southern tip of Africa, the Pyramid Route in the north, the Sea Turtle Route in east Africa, and the Gold Route in the west.

Source: <http://www.openafrica.com/>

For example, the Overberg Crane Group, in conjunction with the local community of landowners, has created four ‘Crane Routes’ in the Overberg region, via the Open Africa initiative. The Group consulted the CAR report in order to establish where they are likely to find the most Cranes, around which to establish their routes.

Mr Wicus Leeuwner, Chairperson of the Overberg Crane Group described the approach and rationale as follows:

So the community itself will establish a route and [Open Africa] will provide, through this huge web site, backing for this route. [] we used the information that we got from the CAR count to establish these routes because we could see from that where we will find the most birds. And the idea with that route is that the presence of the birds will pay for their own conservation. So the farmers get involved in tourist activities through the birds, and because they start making money out of the tourist activities, they will look after the birds. (Wicus Leeuwner, interview)

Mr Leeuwner described some of the other ways in which the CAR data, and other information available at the ADU are used for tourism purposes among the farming community. For example, the community holds fun 4x4 drives through the farms in the area. As part of the drive they ask the participants to identify the birds that they encounter along the way. They use the Bird Atlas data to get the names of the birds found in that district, before the drive begins. Similarly, farmers are increasingly getting involved in the hospitality industry by, for example, setting up bed and breakfast

accommodation on their farms. The farmers have found that the tourists want information on the birds in the area and Mr Leeuwner assists them with accessing the relevant information from the ADU.

5.3 Support and interaction with users: Bridging the ‘knowledge gap’

None of the users of the research who were interviewed reported having much difficulty in understanding or engaging with the CAR data or findings. On the one hand, this might have to do with the user-friendly and accessible style of the CAR reports and newsletters, and the ongoing feedback and interaction between the CAR project team, volunteers and potential users. On the other hand, it appears that there is not so much of a ‘knowledge gap’ between the knowledge producers and users, as is sometimes the case in other contexts. For instance, environmental consultants and nature conservationists usually have university degrees, if not postgraduate qualifications. As Mr Anthony Emery commented, there is therefore not much need for user support around research within the environmental field.

I’ve not really needed [user support], but then I must also say that working within [Endangered Wildlife Trust] with a community of scientists around me, when you run into trouble, there’s always someone who knows more than you, who can assist you. But I’ve always found that just reading, for example, the explanatory notes in the beginning of these things, you know, the methodology etc. If you really read it, it’s not all that difficult to follow what the guys were trying to do. I’ve never looked at it and thought, oh well, I don’t understand at all what’s going on here. I better talk to them and get them to explain it to me. I’ve found it to be, you can take it and you can use it, provided you’ve got some sort of background in how to work with these things. (Chris van Rooyen, interview)

Mr Wicus Leeuwner pointed out that many farmers today also have a university background, with some sort of degree or qualification in agriculture or related disciplines. The current generation is therefore far more accustomed to interacting with university researchers, or with research that is disseminated via agricultural extension services. In addition, farmers now recognise the importance of a holistic approach to farming and conservation, and therefore the need for reliable, scientifically-based information:

I’d say we can’t do enough ever; so any support will be appreciated. I’m not saying that what’s happening already is not good. The more good information a farmer gets, the better, because I think farmers start understanding that they are not farming in isolation anymore, and they are not planting their crop in isolation anymore. They are part of the bigger picture. And because we have a lot of farmers that export fruit and they understand that they can’t just take out one insect and leave a gap there. They have to look at the whole thing holistically. And a lot of the wheat farmers too they have started using practices that are beneficial to the whole spectrum. (Wicus Leeuwner, interview)

Despite this apparent common ground between the knowledge producers and users, both Mr Anthony Emery and Mr Chris van Rooyen warned that people could still make mistakes with the data.

People can still make mistakes in the application of the data. One of the things that people have to be very aware of are the assumptions of the study and the limitations of the data. That's not always spelt out. [] Someone who has done a technical degree, or has not gone through Honours or Masters, may not be aware of those [assumptions]. (Anthony Emery, interview)

I must also add though that some people are not using this correctly. I often see within Eskom that people are taking these things and then using them out of context, trying to simplify it. I don't think it's deliberate. Either it's a matter of not really understanding what the guys were driving at and then using it a little bit out of context, or sometimes not using it to its full potential, that's more the thing. They would make a species list but they wouldn't look at things like the reporting rate and the habitat correlations and stuff like that. (Chris van Rooyen, interview)

These two quotes above highlight the need for a greater measure of absorptive capacity among the users of data of this kind; that is, the ability of individuals to understand and engage with data and findings, on the basis of their background knowledge and experience. In this regard, Mr James Harrison observed that this lack of absorptive capacity is one of the reasons why the ADU prefers clients to approach the Unit to undertake analysis of the data and write the reports on their behalf. Mr Harrison believes that the ADU is best positioned to “extract the value” from the data.

5.4 The need for long-term data collection for effective utilisation?

The need for long-term data collection in order to undertake useful and meaningful analyses has been highlighted on numerous occasions in this report. Lack of adequate data can impact on a project's ability to secure funding and to produce articles for scientific journals. It also has an impact on the utilisation of the results. Within the CAR project, the longest period of data collection has been in the Overberg in the Western Cape. According to Mrs Donella Young, they are aiming to follow the example of other similar projects, such as the Common Bird Census in the United Kingdom, which has been gathering data for nearly thirty years, in order to produce more substantial results:

We feel we are starting to get the results and certainly in the Overberg, which is where it started and which has been running for ten years, we are beginning to see trends. But as you can see in the report, some of these trend graphs are quite short in some areas, like this precinct [pointing to a graph in the report]. So we really need to continue the project for a while before we will get more effective results, because the Overberg is showing very clear trends now, but it does need to continue. (Donella Young, interview, 16 March 2004)

But why is it that the analysis of trends is only meaningful after such a long period of data collection? In short, one requires a number of years of data in order to establish

long-term trends in numbers (whether numbers are increasing, declining or relatively stable) and in order to distinguish this trend from the short-term normal fluctuations in populations (Donella Young, e-mail, 27 July 2004). Prof Les Underhill described the situation in detail as follows:

We can only start to see trends properly once the time series is quite long (10 years is a good minimum). If you do a count in 1994 and 2004, then one cannot really make a statement about trends, because one does not know if 1994 was a “good year” and 2004 was a “bad year”. Having continuous data means that one gets a feel for the (natural) variation in whatever one is measuring. For example, if one is counting occupied penguin burrows on Dassen Island (which is how penguin population trends are determined), and one does it infrequently, then the individual year counts are not terribly useful, because one never knows if one has hit a few good years or poor years. With about 10 years of data, one can hope to start to separate the “noise” (the random variation) from the trend. This has especially been our experience for CAR (see the report, look how much clearer trends are for the Overberg, and how unclear they are for the precincts for which the time series is short). (Les Underhill, e-mail, 28 July 2004)

Mr Anthony Emery, who uses distribution rather than population trend data from the CAR project, suggested that one needs long-term data in order to develop “realistic models”, especially for those species of birds that are difficult to see or to identify in the field, and also to be able to “pick up whether the habitats or distributions have become more restricted” (Anthony Emery, interview).

In short, the longer the CAR project can be sustained and continue to collect annual data, the more opportunities there will be for postgraduate students to engage with the data and begin to answer some of the ‘why’ questions that emerge, and for the project staff to produce more academic outputs. In addition, longer-term data for geographical areas other than the Overberg region will enable a greater number of conservationists and environmental consultants to draw on the data for their own purposes.

6 Concluding observations

The CAR project appears to be representative of much of the work done by staff in the Unit. In particular, it is apparent that the CAR data forms an important part of the larger “repository” of data that the ADU is in the process of establishing. This was evident in the discussions with the three users, each of which reported that they usually consulted the range of relevant data, including the CAR data, available in the Unit. The apparent value of the CAR data, in comparison to the other datasets, is the detail, which is provided about each species, where it is found, what kinds of habitats it lives in and breeding behaviour.

This case study report has highlighted a number of unique features of the CAR project. First among these is the extent to which the project team relies on the mass participation of volunteers, many of whom are drawn from interest groups, such as commercial farmers, nature conservation agencies and bird clubs, but also from the broader spectrum of civil society, including schools. In undertaking the annual roadcounts, these volunteers

perform a role similar to that of survey fieldworkers. More than this, these volunteers are also 'amateur scientists' involved in 'citizen science', insofar as they are exposed to the scientific method; to engaging with scientific results and, in some cases applying these in practice; and, to other features of the research process such as research design and report-writing. This, together with the regular contact and interaction between many of the volunteers and the research team, is believed to heighten the possibility of the research having an impact on attitudes and practice with regard to conservation.

Beyond broad dissemination of the findings and frequent interaction with participants and potential users, the CAR project team does not adopt any particular strategy to ensure effective utilisation of the research. And, as with the Avian Demography Unit as a whole, the CAR researchers do not engage in what might be termed lobbying or activist activities. For Prof Underhill, these activities do not fall within the domain of higher education institutions: "Well, it's not our job to push it to the *n*th degree. It's just not what a university is supposed to do."

Given that the CAR data is made publicly available opens up many opportunities for utilisation, both by postgraduate students and by users in government, conservation agencies, environmental consultancies and tourism bodies. The examples of utilisation described in this report ranged from changes in practice by farmers, the use of CAR data or findings to inform impact assessments (and thereby environmental policy and planning), and ecotourism activities which involve bird-watching.

However, despite the broad potential for utilisation of the CAR data and findings, the limited data collection (in terms of years) in many of the precincts covered during the roadcounts, presents a significant limitation to utilisation. One of the key lessons learnt from this case is that, within the ornithological field, but perhaps also others, monitoring data increases in value when datasets cover at least ten years. Data collected for a period of less than that limits the possibilities for the production of academic or scientific outputs, as well as the potential for utilisation, insofar as the trend analyses are less meaningful. In addition, this feature of the CAR project, as well as the research that is conducted in the Avian Demography Unit as a whole, limits the extent to which researchers are able to secure funding for projects.

The lack of secure and consistent sources of funding for the CAR project appears to threaten its future sustainability, a situation that mirrors that of the ADU as a whole. In part, the funding problem is linked to the issue of insufficient data collection (discussed above) since, according to Prof Underhill; potential funders are less keen to fund projects that do not have substantial products to show. This places the CAR project in something of a Catch-22 since without funding to sustain the project over time, they are unable to demonstrate the real value of the data, and thus present themselves as a more valuable and viable option. In part, however, the lack of funding might also be linked to the broader trend in South Africa currently in which funding for 'people needs' is more readily available than for environmental concerns.

Finally, another unique feature of the CAR project, in terms of the utilisation of the data, is that the 'knowledge gap' between producers and users is not very pronounced, as is

sometimes the case in other utilisation contexts. In particular, the people who are most likely to use monitoring data of this kind, such as conservationists or environmental consultants, are on a par with the knowledge producers in terms of qualifications, educational background and professional experience. There is therefore no need for the CAR project team to undertake any special support for users in terms of, for example, making the research findings more accessible or easier to understand.

Data sources

Face-to-face interviews

Prof Les Underhill (Head: Avian Demography Unit), 16 March 2004

Mrs Donella Young (CAR project co-ordinator), 16 March 2004

Telephonic interviews/feedback discussions

Mr Anthony Emery (Environmental consultant, Emross Consulting (Pty) Ltd), 28 July 2004

Mr Chris van Rooyen (Programme Manager: Eskom-EWT Strategic Partnership),
23 July 2004

Mr Wicus Leeuwner (Farmer in the Caledon area of the Western Cape), 28 July 2004

Mr James Harrison (CAR project manager), 1 September 2004

Mrs Donella Young, 1 September 2004

E-mail responses to additional questions

Prof Les Underhill, 28 July 2004

Mrs Donella Young, 27 July 2004

Questionnaire

'Public sector R&D in South Africa: The production and utilisation of research'
questionnaire completed by Donella Young, March 2004

Publications and documents

Bird Numbers, Vol 11 No 2, December 2002

CAR Eighth Annual Report (November 2001)

DEAT (1997) *White Paper on the Conservation and Sustainable Use of South Africa's Biological Diversity*. Pretoria: Department of Environmental Affairs & Tourism.

Web site: <http://www.environment.gov.za/PolLeg/WhitePapers/Biodiversity/>

Young DJ, Harrison JA, Navarro RA, Anderson MD & Colahan BD (editors) (2003) *Big Birds on Farms: Mazda Car Report 1993-2001*. Cape Town: Avian Demography Unit, University of Cape Town

Young DJ & Harrison JA (2000) *The CAR technique for censusing cranes*. Proceedings of the 12th South African Crane Working Group Workshop, 22-23 November 2000

Appendix 1: Broad recommendations of the CAR report

The three sets of recommendations made in the CAR report (Young *et al* 2003:23-24) are summarised below:

The message to landowners

There are 10 things that landowners can do to improve the conservation of large terrestrial birds on their lands:

1. Adopt mixed farming strategies
2. Use poisons responsibly
3. Monitor overhead utility cables and other potentially dangerous structures
4. Protect natural veld
5. Create habitat corridors
6. Protect wetlands
7. Protect breeding sites
8. Control dogs and cats
9. Educate farm workers
10. Collaborate with others.

The message to conservationists

A quantitative comparison of the CAR precincts highlights that:

1. All precincts have measurable conservation importance for large terrestrial birds
2. Scores based on CAR statistics vary greatly between precincts, with higher scores being concentrated in the east
3. Scores show that some precincts have special importance for certain species
4. Certain precincts are especially valuable to the conservation of large terrestrial birds, particularly these five: Southern Free State, Northeastern Free State, Southern KZN, Northeastern Eastern Cape, and Eastern Karoo.

The message to CAR

CAR delivers conservation-relevant information on the following questions:

1. What large terrestrial birds occur in agricultural landscapes across the country?
2. Do summer and winter counts differ; if so, what does this tell us about the birds' behaviour?
3. What habitats are the birds using and do these differ from place to place?
4. What are the strongholds of species, particularly the threatened species?
5. How are the populations in various areas changing over time and what are the possible causes?

To improve its delivery of information, CAR must firstly continue and secondly expand. Birders and landowners around the country are urged to join this national effort. CAR has the potential to become an early-warning system for a considerable number of threatened species, and therefore its results should reach the right people, quickly.

Appendix 2: CAR publications

Scientific journals

- ◀ Allan DG (1994) 'The abundance and movements of Ludwig's Bustard *Neotis ludwigii*.' *Ostrich* 65: 95-105.
- ◀ Van Rooyen C (2004) 'Review of Young DJ, Harrison JA, Navarro RA, Anderson MD & Colahan BD (eds) (2003) *Big Birds on Farms: Mazda CAR Report 1993-2001*.' *Avian Demography Unit, Cape Town*. 205p. *Ibis* 146: 183.

Book

- ◀ Young DJ, Harrison JA, Navarro RA, Anderson MD & Colahan BD (eds) (2003) *Big Birds on Farms: Mazda CAR Report 1993-2001*. Avian Demography Unit, Cape Town. 205p.

Proceedings

- ◀ Young DJ (1998) 'Investigative Studies 5.1 CAR - Co-ordinated Avifaunal Roadcounts.' In: *Proceedings of South African Crane Working Group and Eskom/EWT National Crane Conservation Project Workshop, Ladybrand, 12 -13 May 1998*: 12-13.
- ◀ Harrison JA, Underhill LG, Young D & Anderson M (2001) 'Report on the SACWG National Crane Census (NCC).' In: *Proceedings of the 12th South African Crane Working Group Workshop, 22-23 November 2000*: 56-61.
- ◀ Shaw K & Hudson V (2001) 'Blue Crane habitat in the Overberg/Swartland.' In: *Proceedings of the 13th South African Crane Working Group Workshop and the South African Strategy Meeting, 14-16 June 2001*: 33-41.
- ◀ Venter J (2001) 'The Karoo habitat of the Blue Crane (*Anthropoides paradiseus*).' In: *Proceedings of the 13th South African Crane Working Group Workshop and the South African Strategy Meeting, 14-16 June 2001*: 27-31.
- ◀ Young DJ & Harrison JA (2001) 'The CAR technique for censusing cranes.' In: *Proceedings of the 12th South African Crane Working Group Workshop, 22-23 November 2000*: 62-72.
- ◀ Young DJ & Harrison JA (2001) 'Population monitoring results for the Blue Crane, *Anthropoides paradiseus*, from Co-ordinated Avifaunal Roadcounts (CAR).; In: *Blue Crane (Anthropoides paradiseus). A Population and Habitat Viability Assessment Workshop. Final Workshop Report, 1-4 October (2001)* McCann K, Morrison K, Byers A, Miller P & Friedmann Y (eds), Appendix 7. Conservation Breeding Specialist Group (SCC/IUCN)., Apple Valley, MN.

Popular publications

- ◀ Allan DG (1994) Haven for Blue Cranes. *African Wildlife* 48: 8-14.
- ◀ Allan DG (1994) The Blue Crane. *Endangered Wildlife* 18: 3.
- ◀ Allan DG (1995) The December 1994 southern Cape Blue Crane and Stanley's Bustard road count. *Bird Numbers* 4: 12-14.

- ⤵ Allan DG & Young DJ (1998) CAR in the Western Cape - the fruits begin to ripen. *Bird Numbers* 7(2): 19-21.
- ⤵ Avian Demography Unit (1998) CAR accelerating. *Africa - Birds & Birding* 3(3): 74.
- ⤵ Avian Demography Unit (2001) Monitoring the 'vulnerable' Stanley's Bustard. *Africa - Birds & Birding* 5(6): 74.
- ⤵ Avian Demography Unit (2003) Big birds on farms. *Africa - Birds & Birding* 8(3): 76.
- ⤵ Bennett S (2000) CAR and CWAC. *Blue Swallow* 13(3): 8-10.
- ⤵ Brett P (2003) Summer CAR count 2003. *BirdLife Eastern Cape News* May 2003: 6-7.
- ⤵ Craig A (2001) CAR count, 27 January 2001, team led by Adrian Craig. *Diaz Diary* 29(2): 11.
- ⤵ Craig A (2004) CAR count: January 2004. *Diaz Diary* 32(1): 15-16.
- ⤵ Gaynor D (2001) CAR counts for July 2000 and January 2001 in the Steenkampsberg. *The Hornbill* 61: 55.
- ⤵ Harrison JA (1995) Co-ordinated Avifaunal Roadcounts. *Bird Numbers* 5: 9.
- ⤵ Hitchcock W I (1996) Co-ordinated Avifaunal Roadcounts. *Bird Numbers* 6: 18-19.
- ⤵ Hulley P (2004) CAR count, 31 January 2004. *Diaz Diary* 32(1): 16.
- ⤵ Mantzel D. (2001) Evening meeting, 14 February 2001. *Diaz Diary* 29(2): 13-14.
- ⤵ Morrison K (1999) CAR counts on the increase. *The Hornbill* 53: 11.
- ⤵ Morrison K (1999) Mpumalanga Highlands CAR count. *The Hornbill* 55: 57-58.
- ⤵ Mullins L (2001) CAR count, 27 January 2001, team led by Pat Hulley. *Diaz Diary* 29(2): 11.
- ⤵ Mullins L (2001) CAR count, 28 July 2001, team led by Pat Hulley. *Diaz Diary* 29(4): 6-7.
- ⤵ Mullins L (2003) CAR count EG03, 25 January 2003. *Diaz Diary* 31(2): 10-12.
- ⤵ Mullins L. (2004) CAR count: the Great Fish River from Carlisle Bridge to Sheldon and back via Ripon Station on the Little Fish, 31st January 2004. *Diaz Diary* 32(1): 16-17.
- ⤵ Peard S (2000) Co-ordinated Avifaunal Roadcount - 29 January 2000. *Tiptol Border Birders Club* 52: 8.
- ⤵ Nixon A (2001) 2001 Winter CAR count. *BirdLife Eastern Cape News* November 2001:4.
- ⤵ Richardson A (2000) CAR count report: 28 - 30 January 2000. *Bokmakierie* 188: 7-8.
- ⤵ Richardson A (2000) Winter "CAR" count in Wakkerstroom. *Bokmakierie* 190: 25-26.
- ⤵ Richardson A (2002) Summer 2002 CAR count in Wakkerstroom – a great success. *Bokmakierie* 197: 18.
- ⤵ Richardson A (2003) A cool summer count. *Bokmakierie* 200: 19.
- ⤵ Richardson A (2003) Warm winter CAR count. *Bokmakierie* 202: 8.

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- Winch G (1998) Co-ordinated Avifaunal Roadcounts (CAR). *Tiptol Border Birders Club* 46: 5.
- Winch G (1999) CAR (Co-ordinated Avifaunal Roadcount) 30 January 1999. *Tiptol Border Birders Club* 48: 8.
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- Young DJ (2001) The White Stork - going where the food is. *Bird Numbers* 10(1): 20-24.
- Young DJ (2002) Co-ordinated Avifaunal Roadcount (CAR). *Crane Link* 11: 9-11.
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- Young DJ (2003) Ten years of counting cranes in the Overberg! *Promerops* 256:9-10.
- Young DJ (2004) Co-ordinated Avifaunal Roadcounts (CAR) Project tracks the changes. *KZN Birds* 9: 15-16.

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- Allan DG & Young DJ (1997) CAR Information Sheet No. 3, Distinguishing Bustards. ADU, Cape Town.
- Allan DG & Young DJ (December 2002) CAR Information Sheet No. 3, Distinguishing Bustards. ADU, Cape Town.

- ◀ Harrison JA & Hitchcock W (1996) CAR Information Sheet No. 2, Setting up routes. ADU, Cape Town.
 - ◀ Harrison JA & Hitchcock W (November 1996) CAR Circular No. 1. ADU, Cape Town.
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 - ◀ Young DJ & Harrison JA (June 1998) CAR Circular No. 4. ADU, Cape Town.
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