

more of the researchers had more practical inclinations and experience, and had a better feeling for what's going on in operations, and vice versa. (Mining: Impala Platinum Mining)

You know, universities are incredibly theoretical, but there's not a lot of practical innovation coming out of a lot of the projects that students do. We're saying, "Well, let us have a look at those papers and we'll see what can be applied as a technology in textiles". (Manufacturing: Gelvenor Textiles)

The researchers like doing the research. They don't like writing it up. And they really don't like turning it into something practical. And we actually have, not quite, but we actually demand our pound of flesh along those lines. We say that coming from a contracting background, the contract is never finished until the paper work is done: "Mr Researcher, your research is not finished until your paper work is done and you've told us the practical uses of it". (Fabricated metal products & machinery: South African Institute for Steel Construction)

... our experience is that universities are not commercial institutions. They generally don't understand commerce and that is why we prefer to keep it nice and simple. (Electronic hardware, systems & software: Grintek (2))

Universities particularly focus on making a molecule, whether it gives a 5% yield, whether it is factory friendly, it doesn't matter, as long as you can make it and then you have achieved your goal. Where for us it is really making a product, where you take into account environmental aspects, whether it can be done in production. You take into account the costs obviously involved. Often projects will be discontinued, because either from a cost point of view or an environmental point of view, whereas at a university, they don't take that into consideration. (Chemicals: Fine Chemicals Corporation)

And then if you look at universities, I guess the only complaint is that they take a lot of time. As the departments start to realise that things are changing, they pick up their administration and you know, previously universities did things sort of at their own pace that suited them but, fortunately, you find now that departments are starting to realise that they need to get going, get proper feedback going and put structures in place to ensure efficient research without giving away their freedom. I think it is a difficult thing for them to manage and I feel sorry for them, but that is how it is. (Fabricated metal products & machinery: Columbus Stainless)

It is a concern. I have tried, for instance, to approach our universities to do projects but the university agenda is at odds with the industrial agenda. My requirement is to have projects done very quickly and almost on a fulltime basis, whereas the university agenda is to stretch something over a student's

career, over a year or maybe two years. So there is a conflict of interest there. (Electronic hardware, systems & software: Fuchs Electronics)

The key component in that was ensuring that we didn't target an institution because it was labelled as a good commerce or biotechnology. The key issue there was to look for productive individuals, productive academics, who were moving ahead, who were rated, who were attracting students, who could get the work done for us. (Agriculture, forestry, fishing & hunting: Mondi Forests Ltd)

9.8 Limited or stagnating local markets

Limited or stagnating local markets can reduce the demand for particular R&D activities, or they can impact on the company's success in getting their products to market.

On the hindering side I suppose like all businesses is orders. Some of our work is directed to Spoornet and they haven't placed new orders for a long time ... In other words that market hasn't really grown. (Fabricated metal products & machinery: Dorbyl Engineering (2))

I don't think that the need has diminished. I think that there has been a significant down turn in our industry. ... Locally there has been a huge down turn in the last 10 years, to the extent that this whole industry was under serious threat and much of the effort has gone into rather product development for application in the export market, and downscaling the staff has been quite common. So for that reason very little has gone into research-type work, which is a pity but due to the down turn one understands it. (Electronic hardware, systems & software: Grintek (3))

But, we still can't sell a metre in South Africa. (Manufacturing: Gelvenor Textiles)

9.9 Negative attitudes towards innovation/R&D

Finally, respondents indicated that sometimes either company management or end-users (internal or external) exhibit a negative attitude towards innovation and/or the role of R&D in contributing to the overall performance of the company. This can inhibit the successful uptake of R&D results.

Respondents reported that sometimes management have little appreciation for the real or potential value of R&D to a company's growth and competitiveness. In part this has to do with a lack of understanding about exactly what goes in R&D and how it functions within the broader business operations. As a result, management can be resistant towards and unsupportive of proposals for R&D to be undertaken. On the other hand, end-users can also be resistant to accepting and adopting the changes suggested by R&D that can lead to no utilisation taking place at all.

Some sort of a higher technical literacy among the management would have been very helpful. Say it's in a sense, you could argue, it's an

internal problem to the company, but I think it's a symptom of the South African economy. We find great difficulty in it. There's very poor appreciation of what the R&D's role is in the company and what it should be doing. (Mining: De Beers (2))

One of the other issues is more on the technology transfer side, is getting the growers to implement the results of the research. Even if you go to a lot of trouble in technology transfer and making sure that they know what the results are, it doesn't mean to say that they will implement them. ... It is perhaps just the conservative nature of a lot of the growers in doing what they know rather than trying something new. So in the past we used to have extension officers who could virtually show that person on the farm how to do things, but we don't have that personnel any more and it is up to the farmer to grasp from the various means of communication what he needs to do and implement it himself. Some do and some don't. (Agriculture, forestry, fishing & hunting: Citrus Research Institute)

There is also a tendency amongst many, many organisations to suffer from the 'not invented here' syndrome. They don't like other people's ideas. In fact when I put forward the idea that we have a research centre, nobody liked it. So, I think the people and their past education, and perhaps the fact that they used to work in a very different world – not the global village that we have become so familiar with - I think those are some of the constraints in utilising knowledge that is readily available. (Chemicals: Plasco)

In summary, company R&D is a complex and costly process. It involves a diverse range of stakeholders who have a variety of (sometimes conflicting) needs. R&D also makes enormous demands in terms of finances, highly skilled human resources and specialised equipment and facilities. It is therefore not surprising that companies experience so many challenges along the way. What this means, however, is that factors which will inhibit the ultimately successful uptake and utilisation of R&D can arise *throughout* the R&D process. These are summarised in the concluding chapter of this report.

While companies are faced by many challenges in seeing their R&D undertaken and brought to fruition, there are some factors, which put a positive spin on company R&D locally. The following chapter considers some of the strategies that companies have adopted in order to stimulate R&D and ensure that it is effectively utilised, as well as some of the valuable resources available to individual companies, or that are specific to South Africa, which promote company R&D.

CHAPTER 10

FACTORS THAT PROMOTE R&D AND TECHNOLOGY TRANSFER

Respondents reported a range of factors, which contribute positively to company R&D. Some of these factors relate directly to the circumstances of and approaches adopted by individual companies. For instance, some companies are simply well endowed in terms of finances, human resources and a solid knowledgebase. Others attribute their success to a positive attitude towards innovation and R&D within the company, and incentives for their own staff to develop their skills in conducting R&D and implementing or applying the results. Other promoting factors were more indirectly related to characteristics of the South African context that were particularly advantageous in terms of R&D.

All in all, respondents offered useful insights and ideas about how to stimulate company R&D in this country.

10.1 Adequate financial, human and knowledge resources

Some respondents indicated that they are adequately equipped in terms of financial and human resources, and access to knowledge and information. The government's contribution to company R&D, via funding mechanisms such as THRIP, was also acknowledged and appreciated.

Something which maybe promotes is... we do get resourced. Unilever provides the means or human capital to make it happen. So that is one thing that we have, a very strong – we have the availability of cash and resources in our hands ... (Chemicals: Unilever)

... we have great appreciation for a number of initiatives that the government has put in place to provide funding for local development. (Electronic hardware, systems & software: Grintek (2))

I must say, from our industry's point of view, an additional Rand-for-Rand has really been able to make a programme like the Stellenbosch one work, by not quite, but almost doubling the sums they are able to get in industry. And that is making the difference between just another bit of research and a really meaningful approach. (Fabricated metal products & machinery: South African Institute for Steel Construction)

Quite a bit of our work at the research centre has been supported by government funding. We haven't always spent only our money - we spent our money and government funding. We have out of this been able to bring benefit to the university. Stellenbosch has benefited from the money we have spent at the university. Trips have been made possible for the Department of Polymer Science out of our participation. I am very pleased at the kind of availability and accessibility of government funding. I think they're doing a great job. (Chemicals: Plascon)

We value this calibre of person very highly in our group of companies. We have a very high portion of technically qualified people in our main staff complement. (Electronic hardware, systems & software: Grintek (2))

... what helps us is that we've got an extremely innovative team of people that work for us. (Chemicals: Keyplan Engineers)

We have that some of our highly skilled people leave and some of them have emigrated, but I don't think it seriously held back by that. It's not a genuine inhibiting factor; there are other good people coming available out of the universities and in general we have been able to get the people we need. (Electronic hardware, systems & software: Tellumat)

We've got a very big library here on geosynthetics. It's probably the biggest library on geosynthetics in the whole of the southern hemisphere, because we've been going for twenty-seven years now. There is a lot of knowledge here. I've got colleagues with a lot of knowledge on geosynthetics and so I do draw on their information. (Manufacturing: Kaytech)

One of the things we do have is a strong international network. We do have sister institutes in all developed countries in the world. We have big brother institutes in America, Canada and UK. We have similar size institutes in most European countries, in Australia, New Zealand and we have a very good international network of passing information on. (Fabricated metal products & machinery: South African Institute for Steel Construction)

10.2 Company geared towards innovation and R&D

Certain companies are entirely focused on change and innovation within their business operations that means that they respond proactively to the innovation imperative, and offer incentives to their staff to be as innovative as possible. It also means that management values the role of R&D in the company, and provides adequate funding and strong support to the R&D function. One company in particular appears to have taken great strides towards 'institutionalising' R&D and innovation by, amongst others, developing an intranet system which facilitates and integrates communication and the sharing of new ideas and findings around R&D within the company.

Promoting factors: our company is quite active, quite proactive in actually getting people on the floor to come up with creative ideas, the idea being that people who know the business best are the people who can innovate best. They come up with the most preferred solution. So, there are drives towards, you know, idea boxes, a reward principle for people who come up with innovative operational techniques or ways to save money and stuff like that. (Services & infrastructure: National Ports Authority)

What we have done there is we have developed on our intranet what we call 'R&D IQ', which allows us and people (we particularly want to stimulate innovation in the organisation) to put innovation ideas. They will be able to

log on, go into the system and then at the click of a button, it would go through to a number of appropriate R&D managers, via email. And then we would almost develop a chat line, and we would see what it is and how we should expand it further. (Services & infrastructure: Eskom)

[R&D] is very integral to our main line of business and I think what is important as well is that it has extremely strong support from the managerial board and the organisation. (Services & infrastructure: Eskom)

I think what is very important to know is that every year I go to management board and I have to say to them, “Mr Chairman, I need so many million a year for next year”, or the next five years. And what we normally get is, in principle, support for the five-year period, which I believe is absolutely crucial for the sustainability of any research organisation. There is no way that we can plan from one year to the next, because some of our projects last for five, six or seven years. If an organisation believes they are going to be competitively advantaged to technology and they have a one-year window frame, they are going to lose it. I think this is why it is so important that our technology roadmap highlights those issues and I believe the role of the technology roadmap is key and paramount in the way we do things. (Services & infrastructure: Eskom)

So, what we are saying is that our overheads are extremely low and we need to do that to ensure that we spend money on R&D, rather than wasteful administration. ... I have a staff complement of 13, including myself, but I have six research managers, operational managers, who each look after a budget of around about R30m. And the reason why they and their assistants can do it is that we have developed an intranet software system that manages it, all our projects. ... So, everything is online, so that any contractor or researcher within Eskom can log on every day and he can see exactly what his needs are in terms of the project process. So, it makes life a lot easier and the management side, in terms of nitty-gritty admin, is all on the system. Every report or every product that is developed goes to the steering committee; it goes out and it is all logged on the system. We are in the process of having a voice interactive system so that even the steering committee members don't even have to go onto the computer. They just phone in and talk on the telephone – using voice-recognition – it is automatically put on our database. So it's all there, all logged and we know exactly what each product means to each of our internal customers, which is very important. So that, in actual fact, pays a lot on the daily administration of the projects, makes life a hell of a lot easier. So that is why our overhead costs have been and will not go above round about 6% per annum. It is extremely efficient. (Services & infrastructure: Eskom)

10.3 Good human resources management

Some firms have been successful in implementing strategies to attract and retain key R&D staff, through incentives and opportunities for development and promotion.

... there are incentives. We've got a separate, what we term a technical ladder, for technical advancements, which is parallel to the management one, which is normally the one that people jump on to get quick promotions. So there is a career path for scientists up to the highest level in the company. And it totally relies, like an academic institution, on peer recognition and superior recognition and fulfilling certain criteria on this ladder. It is a very scientific, technologically driven ladder. (Chemicals: AECI African Explosives)

... our normal financial incentives - like share options and those things, golden cufflinks that tie people down that little bit longer. (Electronic hardware, systems & software: Nanoteq)

... these people have quite a stimulating environment. There are opportunities, so if they get bored they can change into other technologies; opportunities to go and work overseas for a few years. So, I think there are a lot of personal development opportunities for them, and that is why we are able to actually keep people. And if someone wants to go overseas or move or something, he is in a global network, so he can still get a job overseas. We are not against it if someone wants to move to Germany – we will actually try and arrange it, because it is still part of the same network of people. (Electronic hardware, systems & software: Siemens Telecommunications)

We actually also see our research facility as a training ground. We tend to use a number of young graduates, skill them up and move them into the operational areas, and so this provides good training ground ... (Agriculture, forestry, fishing & hunting: SAPPI)

10.4 Evaluating the outcomes of company R&D

One respondent spoke of the system of evaluating the outputs and outcomes of R&D activities in his company. The company evaluates their numerous R&D projects via customer feedback and a “return-rate on investment” (RRI) exercise. Clearly, this kind of evaluative exercise can play a significant role in ensuring that R&D is effectively utilised in the long run. It is also a way of demonstrating the real and potential value of R&D to the firm.

... all those RRI's of our seven hundred projects would be audited twice a year. We have just gone through one audit now, and that would be the discounted flow rate, the flush flows, projected over the next five years. We would do that twice a year. Every audited RRI would then be completed; documents would be put out and I would actually them present this to my board, and what is happening generally is that for every buck that I spend, I

am showing a R5 return. So it is a 5:1 RRI, and because of the robustness of the audit in the process that we utilise, it seems pretty well accepted that it has been very key in increasing our R&D expenditure over the last ten years. (Services & infrastructure: Eskom)

10.5 The 'South African advantage'

While a number of respondents highlighted the disadvantages associated with conducting R&D in South Africa (e.g. the limited skills base or the lack of adequate funding), others indicated that these factors could in fact be viewed as advantages. In particular, respondents reported that South Africa is regarded as a *quality but inexpensive* site for R&D for companies abroad. In other words, skilled labour is comparatively cheap but, as a few respondents indicated, overseas companies find South Africans to be hard workers and, therefore, comparatively more productive. This is possibly easiest within multinational corporations since the necessary linkages are already there. This is an opportunity to be exploited: if local and overseas companies were to invest more in R&D in South Africa, this would generate additional funding and contracts, and help to build our R&D capacity in the future.

In our experience we have found that at least process development in SA is very cost effective worldwide. (Chemicals: AECI Bioproducts)

I think that what is good is that we have very capable multidisciplinary, generalists type people in the country and that means that we can get by with generally smaller teams equivalent programme internationally ... We are also a lot more specific, especially currently with the Rand having a low value so when it comes to non-recurring type work, customisation for low volume systems is competitive which is good. (Electronic hardware, systems & software: Grintek (3))

There are certainly incentives for the group for VW in Germany to use us as a development facility, certainly. Our rates are dramatically lower than European rates; we are far more cost effective. (Fabricated metal products & machinery: Volkswagen SA)

We have a huge cost advantage, so work done here is roughly 20% to 25% of doing work in the US or so. So, it makes a lot of sense to move more R&D to SA. Companies have tried this with other developing countries, like India, for example, but I think we have a specific niche in being able to provide the kind of customer communications and interfacing, which is on a parallel on what you would get in First World countries, but combined with a lot of costs as well. (Electronic hardware, systems & software: Azisa)

I do feel the South African climate does create a lot of ... we are fearless enough, we are not worried to innovate and create things, even if we sometimes reinvent the wheel. And out of that sometimes comes a lot of good and new ideas ... (Electronic hardware, systems & software: Nanoteq)

It is much cheaper for them to do it here, so currently there is a worldwide trend to look for cheaper countries, but with skilled staff. (Electronic hardware, systems & software: Siemens Telecommunications)

In summary, some companies have been successful in overcoming the challenges surrounding company R&D in this country. Internally, companies have found ways to tap into and retain highly skilled staff, or to leverage adequate funding to successfully pursue R&D and ensure its effective utilisation. Largely, these measures are a function of a positive and proactive attitude towards R&D and innovation.

Externally, some companies have recognised that South Africa has a unique advantage which can be exploited: our 'competitive edge' internationally is rooted in the combination of so-called 'first' and 'third world' attributes, for example, top class infrastructure but cheap skilled labour and overheads. Certainly, if we encourage companies abroad to bring their R&D requirements to this country, this could amount to a considerable investment in R&D in South Africa. It could expand the skills and knowledge bases in the country, and create important links with companies and organisations abroad. This is an opportunity to put South Africa on the global R&D map.

CHAPTER 11

CONCLUDING COMMENTS

This report has documented and discussed a range of information concerning company R&D in South Africa, generated from the industry interviews. We have considered the factors, which drive company R&D, and how these are translated into an R&D agenda. We have also considered the modes of knowledge production inherent in company R&D, as well as the involvement of others in the R&D process through collaboration and outsourcing. The nature of the outputs of company R&D, and the way in which these are disseminated to users, was also explored.

The report then turned to the question of the utilisation, or otherwise, of R&D outputs. We began by looking at the benefits derived from the utilisation of R&D, and who the users are. We then turned to an investigation of the factors that either limit or result in no utilisation. Finally, we considered respondents' ideas and insights into how to ensure that company R&D is successful and, more importantly, that the outputs are effectively utilised.

By way of summarising the factors that impact on company R&D and, in particular, those which inhibit or result in no utilisation of R&D outputs, we have attempted to match each of these factors to the particular stage in the process of innovation in which they are likely to occur. Some of the major themes running through this analysis have included issues to do with human resources, funding, intellectual property and the importance of tacit knowledge in the process of technology transfer. In many respects, these factors cut across all stages of the innovation process.

Table 11.1: Factors that limit utilisation

Stage in the innovation process	Limiting factors
Setting the R&D agenda	<ul style="list-style-type: none">– Inadequate information can lead to the poor conceptualisation of an R&D project, which later might result in a product that is inappropriate and which cannot be used– A lack of proper consultation with intended users at the start can lead to problems with utilisation later on (cf the fit between purpose and intended user and users)
R&D activities	<ul style="list-style-type: none">– The quality and ultimate success of R&D might be compromised by a lack of skills, equipment, information or funding, or by political pressure– Longer-term, basic research is under greater threat than short-term, application-driven R&D of not being utilised, or pursued in the first place

Table 11.1 Continued

Stage in the innovation process	Limiting factors
Dissemination	<ul style="list-style-type: none"> – Dissemination of R&D outputs is usually restricted (e.g. patents, licenses, keeping it internal) which reduces the amount of information or knowledge available to South African industry as a whole – Wider dissemination (e.g. in journals or at conferences) is also limited and is usually too general or out-of-date to be of much immediate use
Commercialisation	<ul style="list-style-type: none"> – The more theoretical orientation of many academics and public sector scientists can lead to results which are too impractical to properly commercialise – A lack of funds can result in the product not being commercialised (note that government funding does not cover commercialisation)
Technology transfer	<ul style="list-style-type: none"> – When the tacit knowledge associated with the R&D process and outputs is not transferred, this can result in limited or no utilisation on the part of users (cf the absorptive capacity of firms) – In cases where technology transfer is institutionalised, e.g. in agricultural extension, a lack of resources, both human and financial, can result in very limited utilisation or implementation. – When users are sceptical about the value of the change suggested by the R&D, do not have the skills to apply R&D outputs in their own contexts, or who are simply resistant to change, they are likely to not use the R&D at all
Product launch	<ul style="list-style-type: none"> – The outputs of R&D will not be effectively utilised if there is no market for product, or the product turns out to not be competitive. To some extent, this could be because the company did not do its homework properly! – R&D activities might not be realised if a competitor gets to the market first
Evaluating the outcomes of R&D	<ul style="list-style-type: none"> – Companies would do well to implement a system of ongoing monitoring and evaluation of the process, outcomes and utilisation of R&D

Finally, the industry data suggests a number of ideas on how to optimise the effective utilisation of company R&D:

- 1) In the interests of industrial and economic development in the country, the government could consider some form of incentive for companies to pursue R&D.
- 2) Human resource capacity is a major issue. Already many of the 'solutions' are on the national agenda (science and maths graduates, improved participation and throughput rates in HE, etc). Nevertheless, many of these are very long-term solutions. A short-term option to consider is recruiting skills from abroad. The

government's 'restrictive' immigration policy is an issue in this regard (see, for example, Crush, McDonald & Williams 2000:2; Mattes, Crush & Richmond 2000:12). We also need proactive policies to address the ageing/shrinking scientific workforce in the public sector.

- 3) Government funding policies and processes could be improved. For example, the process could be streamlined to ensure that the 'turnaround' is quick enough for companies to pursue their opportunities. Government funding could also be extended to ensure that company R&D reaches the stage of commercialisation.
 - 4) Both companies and their collaborating or contractual partners could consider the process of technology transfer itself. This might involve, for instance, training and other forms of knowledge transfer between producers and users of R&D to ensure effective utilisation, or the use of networks and software to facilitate communication and transfer internally.
 - 5) Finally, both the public and private sectors could usefully exploit the fact that South Africa is considered to be a cheap site for R&D (particularly in terms of labour), but that it is also considered to have some quality expertise available. This would help to grow our own capacity.
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