Wine scientists and winemakers as two communities: Bridging the gap through boundary-spanning activities

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DECLARATION

By submitting this dissertation electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

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ABSTRACT

It is believed that investments in academic research and development have contributed to new world wine-producing countries entering the international wine markets, traditionally dominated by European countries such as France, Italy and Spain. This has increased the competition for "shelf space" in supermarkets and restaurants. Wine industries that want to maintain and grow sales need to innovate to remain competitive. South Africa exports approximately half of the wine it produces. The industry's sustainability is strongly dependent on healthy domestic and export sales.

Academic knowledge production and effective knowledge transfer assist practitioners with making informed decisions to avoid mistakes and innovate. The South African wine industry comprises an extensive knowledge network with many actors, including researchers, practitioners and intermediaries. An adequate knowledge creation and dissemination system must be maintained for the industry to be competitive internationally, especially against the country's political past.

This study investigated the knowledge-related interactions between oenology researchers from the Department of Viticulture and Oenology, Stellenbosch University and South African winemakers. The role of intermediaries in the knowledge network was also explored. Researchers and practitioners have been described as two communities operating in different worlds, speaking different languages, and having different evaluation systems. For effective knowledge transfer, both communities need to be cognisant of each other's worlds, and effective boundary-spanning activities must be in place. In this study, the world of academic researchers, in general, was demonstrated through a literature study that focused on knowledge production in the context of application and scientific communication. This was to sketch the background on which the empirical study of the Stellenbosch University oenology researchers was based. A documentary analysis of Stellenbosch University provided the background of the university's population of oenology researchers (11 in total) who were subsequently interviewed.

Results from the empirical study showed that most of the oenology researchers have received industry funding in the past or did so at the time of the interviews, either from Winetech (the South African wine industry research funding body) or international suppliers of oenological products. Most researchers described their research as containing excellence and relevance elements to satisfy academic evaluation systems and industry funders' needs for applicability. Most researchers indicated their willingness to communicate with the industry; some do so more than others, despite specific individual and organisational constraints.

The world of winemakers was sketched through a literature study component and an overview of the South African wine industry. This provided the background for the online survey of winemakers (124 responses) and the 20 winemaker interviews. The results indicated that winemakers use a variety of knowledge sources. They prefer social and experiential learning to factual learning. Their preferred knowledge sources are peers, suppliers of oenological products and services and the internet. Results also showed that the intermediary Winetech and oenological suppliers play crucial roles in creating awareness of new research and innovations.

The study concludes by providing recommendations to the Department of Viticulture and Oenology, Winetech and South African winemakers on improving their boundary-spanning activities.

The study contributes to the academic engagement and knowledge transfer literature mostly focused on academia. Studies jointly investigating academics, practitioners, and intermediaries are very scarce. Finally, the study also identified research needs for future studies.

OPSOMMING

Daar word geglo dat befondsing van akademiese navorsing en ontwikkeling daartoe bygedra het dat "nuwe wêreld" wynproduserende lande die internasionale wynmarkte, wat tradisioneel deur Europese lande soos Frankryk, Italië en Spanje oorheers was, betree het. Dit het die mededinging vir "rakspasie" in supermarkte en restourante vergroot. Wynbedrywe wat verkope wil handhaaf en laat groei, moet innoveer om mededingend te bly. Suid-Afrika voer ongeveer die helfte van die wyn uit wat dit produseer. Die bedryf se volhoubaarheid is sterk van gesonde binnelandse en uitvoerverkope, afhanklik.

Akademiese navorsing en effektiewe kennisoordrag help praktisyns om ingeligte besluite te neem om sodoende foute te vermy en te innoveer. Die Suid-Afrikaanse wynbedryf bestaan uit 'n uitgebreide kennisnetwerk met baie rolspelers, insluitend navorsers, praktisyns en tussengangers. 'n Voldoende navorsings- en kennis-oordragstelsel moet gehandhaaf word sodat die bedryf internasionaal mededingend kan wees, veral teen die land se politieke verlede.

Hierdie studie het die kennisverwante interaksies tussen wynkundenavorsers van die Departement Wingerd- en Wynkunde (Universiteit Stellenbosch) en Suid-Afrikaanse wynmakers ondersoek. Die rol van tussengangers in die kennisnetwerk is ook ondersoek. Navorsers en praktisyns word beskryf as twee gemeenskappe met verskillende wêrelde, tale en evalueringstelsels. Vir effektiewe kennisoordrag moet beide gemeenskappe van mekaar se wêrelde bewus wees en doeltreffende grensoorspandende aktiwiteite moet in plek wees. In hierdie studie is die wêreld van akademiese navorsers in die algemeen gedemonstreer deur 'n literatuurstudie wat op kennisproduksie in die konteks van toepassing en wetenskaplike kommunikasie, gefokus het. Dit was om die agtergrond te skets waarop die empiriese studie van die Universiteit Stellenbosch wynkunde-navorsers gebaseer is. 'n Dokumentêre ontleding van die Universiteit Stellenbosch het die spesifieke agtergrond van die universiteit se populasie van wynkunde-navorsers (11 in totaal), wat ondervra is, verskaf.

Resultate van die empiriese studie het getoon dat die meeste wynkundenavorsers in die verlede, of ten tyde van die onderhoude, bedryfsbefondsing ontvang het, hetsy van Winetech (die Suid-Afrikaanse wynbedryf navorsingsfinansieringsliggaam) of internasionale verskaffers van wynkundige produkte. Die meeste navorsers het beskryf dat hul navorsing akademiese uitnemendheid en relevansie-elemente bevat. Dit is om aan beide akademiese evalueringstelsels en bedryfsbefondsers se toepaslikheidsbehoeftes, te voldoen. Die meeste navorsers het aangedui dat hulle bereid is om met

die bedryf te kommunikeer; sommige doen dit meer as ander ten spyte van spesifieke individuele en organisatoriese beperkings.

Die wêreld van wynmakers is geskets deur 'n literatuurstudie-komponent en 'n oorsig van die Suid-Afrikaanse wynbedryf. Dit het die agtergrond verskaf vir die resultate van die aanlyn-opname van wynmakers (124 response) en die 20 wynmaker-onderhoude. Die resultate het aangedui dat wynmakers 'n verskeidenheid kennisbronne gebruik. Hulle verkies sosiale en ervaringsleer bo feitelike leer. Hul voorkeurkennisbronne is ander wynmakers, verskaffers van wynkundige produkte en dienste en die internet. Resultate het ook getoon dat die tussengangers Winetech en wynkundige verskaffers van produkte en dienste deurslaggewende rolle, om bewustheid van nuwe navorsing en innovasies te skep, speel.

Die studie sluit af deur aanbevelings aan die Departement Wingerd- en Wynkunde, Winetech en Suid-Afrikaanse wynmakers te verskaf oor hoe om hul grensoorspandende aktiwiteite te verbeter.

Die studie dra by tot die akademiese betrokkenheid en kennisoordrag literatuur wat meestal op akademiese navorsers gefokus is. Studies wat akademici, praktisyns en tussengangers gesamentlik ondersoek, is baie skaars. Laastens het die studie ook navorsingsbehoeftes vir toekomstige studies geïdentifiseer.

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LIST OF ACRONYMS

AAS	African Academy of Sciences
AJEV	American Journal of Enology and Viticulture
APC	Article Processing Charge
ARC	Agricultural Research Council
B.Sc. Agric	Bachelor of Science in Agriculture
BMC	BioMed Central
BMJ	British Medical Journal
BOAI	Budapest Open Access Initiative
CAQDAS	Computer-aided Qualitative Data Analysis Software
CEO	Chief Executive Officer
COVID-19	Coronavirus disease 2019
CREST	Centre for Research on Evaluation, Science and Technology
CWA	Cape Wine Academy
DHET	Department of Higher Education and Training
DORA	Declaration on Research Assessment
DSI	Department of Science and Innovation
dti	Department of Trade and Industry
DVO	Department of Viticulture and Oenology
FLAIR	Future Leaders African Independent Research
HACCP	Hazard Analysis Critical Control Point
Hons B.Sc.	Honours Bachelor of Science
IBSS	International Bibliography of the Social Sciences
ICTs	Information Communication Technologies
IF	Impact Factor
IGWS	Institute for Grape and Wine Sciences
IPW	Integrated Production of Wine
ISI	Institute for Scientific Information
ISO	International Organization for Standardization
IWBT	Institute for Wine Biotechnology
JCR	Journal Citation Report

JIF	Journal Impact Factor
KT	Knowledge transfer
KWV	Ko-operatiewe Wijnmakersvereeniging
M.Sc. Agric	Master of Science in Agriculture
NAFU	National African Farmers Union
NAMC	National Agricultural Marketing Council
NPC	Nonprofit Company
NRF	National Research Foundation
NWGIC	National Wine and Grape Industry Centre
OA	Open Access
OASPA	Open Access Scholarly Publishers' Association
OECD	Organisation for Economic Co-operation and Development
PhD	Doctor of Philosophy
PLACE	Proprietary, Local, Authoritarian, Commissioned and Expert
PLOS	Public Library of Science
QS	Quacquarelli Symonds
R&D	Research and Development
REC	Research Ethics Committee
RIIS	Research Institute for Innovation and Sustainability
RTD	Ready to Drink
SA	South Africa
SAGWRI	South African Grape and Wine Research Institute
SAJEV	South African Journal of Enology and Viticulture
SALBA	South African Liquor Brand Owners Association
SAQA	South African Qualifications Authority
SARChi	South African Research Chairs Initiatives
SASEV	South African Society for Enology and Viticulture
SAWID	South African Wine Industry Directory
SAWIPB	South African Wine Industry Professional Body
SAWIS	South African Wine Industry Information Systems
SAWIT	South African Wine Industry Trust
SAWITU	South African Wine Industry Transformation Unit

SCI	Science Citation Index
SU	Stellenbosch University
THRIP	Technology and Human Resources for Industry Programme
UCT	University of Cape Town
UK	United Kingdom
US	United States
USA	United States of America
UWC	University of the Western Cape
WIETA	Wine & Agricultural Ethical Trade Association
Winetech	Wine Industry Network of Expertise and Technology
WOS	Web of Science
WoSA	Wines of South Africa
WSU	Washington State University

CHAPTER 1: INTRODUCTION

1.1 RESEARCH BACKGROUND

Scientific knowledge plays a fundamental role in a country's economic growth, technological performance and international competitiveness. As a result, universities – the leading producers of scientific knowledge – have become key players in national innovation systems (Gulbrandsen & Smeby, 2005; Geuna & Muscio, 2009; Ylijoki, Lyytinen & Marttila, 2011). Policymakers see collaboration between universities and industries as a transference mechanism to ensure that academic research impacts society and the economy (Ankrah & AL-Tabbaa, 2015). Research in the field of policy development has identified three models whereby knowledge produced by academia can be transferred to industries (Weiss, 1979; Landry, Amara & Lamari, 2001).

- The *science-push* model conceptualises knowledge transfer as a unidirectional flow of information from academic researchers to policymakers, resulting in specific policy decisions.
- The *demand-pull* model conceptualises policymakers commissioning research from researchers to address a well-defined policy problem.
- The *interactive* model conceptualises knowledge transfer as a mutual and reciprocal activity between researchers and users in developing, conducting, interpreting and applying research-based knowledge.

The failure to effectively transfer knowledge between researchers and users has been attributed to the 'two communities' problem described by Caplan (1979). His conception of the matter describes researchers and users as living in separate worlds with different and often conflicting values, reward systems and languages. These cultural differences can lead to barriers to researcher-user engagements and knowledge transfer.

To bridge the gap and facilitate effective knowledge transfer between the two communities, boundary-spanning activities need to exist. A boundary is defined as "the demarcation line or region between one system or another, that protects the members of the system from extra-systemic influences, and that regulates the flow of information, material and people into or out of the system" (Leifer & Delbecq, 1978, p. 41). For example, members and systems can be a community of researchers in a university system and a community of users in an industrial system. Boundary spanning activities refer to practices and tools that could facilitate knowledge exchange across the boundary between these two systems.

This dissertation focuses on a specific industry, namely the wine industry of South Africa and its community of winemakers and a specific group of university researchers, i.e., oenology[1] researchers of Stellenbosch University. They conduct research that has relevance to the community of winemakers. The empirical study focused on the boundary-spanning activities between these two communities and the role of intermediaries in facilitating knowledge transfer in the South African wine industry.

The reason for focusing on the wine industry is because wine industries of the world have experienced a process of modernisation and dramatic technological change due to increased interaction between researchers and industry and the results of applied research (Giuliani, Morrison, Pietrobelli & Rabelotti, 2010). Over the past decade, several studies have focused on knowledge transfer and uptake in specific countries' wine industries. The studies either focused on grape growers and viticulturists only (Hoffman, Lubell & Hillis, 2014; Lubell, Niles & Hoffman, 2014; Dippenaar, 2017), winemakers and intermediaries only (Boshoff, 2014a) or a combination of grape growers and winemakers (Hill, Hathaway, Wilkinson & Krstic, 2015; Szymanski & Davis, 2015). Only one study focused on the industry engagement of academic researchers involved in wine-related disciplines (Giuliani et al., 2010). Therefore, this study's unique contribution is exploring researchers, intermediaries and winemakers in the South African wine industry. It explores the different worlds researchers and winemakers operate in and how it influences their knowledge production, transfer and uptake activities. In doing so, the study aims to provide boundary-spanning recommendations to strengthen knowledge exchange between oenology researchers and winemakers.

This study focused on individuals that engage (or do not engage) in university-industry knowledge transfer. According to Ankrah, Burgess, Grimshaw and Shaw (2013), previous studies on individual actors involved in university-industry knowledge transfer mainly focused on one group, usually the academic community. Of the studies they reviewed, 49% were on academics, 28% included academics and practitioners (with one of the studies also including intermediaries), and 19% included only practitioners. Only one study focused on intermediaries exclusively. Intermediaries are also called brokers or boundary spanners, depending on the specific research field describing these people or organisations (Neal, Neal & Brutzman, 2021). Intermediaries (the term used in this dissertation)

[1] Oenology is the study of winemaking.

facilitate the engagement process between research and industry (Ankrah et al., 2013). This study contributes to the academic literature that includes researchers, practitioners and intermediaries.

Sections 1.3, 1.4 and 1.5 provide brief backgrounds on the definition of knowledge, the economics of knowledge production at universities, knowledge transfer and knowledge uptake and utilisation. It is important to note that knowledge production, transfer and utilisation is not necessarily a linear process. Some of the actions can happen concurrently.

In the case of knowledge uptake by practitioners, it is also important to note that practitioners do not just take up and use factual knowledge created and transferred by universities via formal channels. They also utilise the knowledge obtained through social learning via informal channels such as via other practitioners (Hoffman, Lubell & Hillis, 2015).

1.2 DEFINING KNOWLEDGE

To report on knowledge production and the transfer, uptake and utilisation of knowledge, it is essential first to define “knowledge” and what types of knowledge exist that can be produced, transferred and used.

According to Malik (2002), knowledge is information that is fully understood and learned and has become the individual’s property. Slaughter and Kirsch (2006, p. 303) define knowledge as “information possessed by an individual that, when combined with other personal dimensions such as experience and reflection, becomes a basis for action”. There can be more than one type of knowledge. Polanyi (1966) was the first to categorise knowledge into explicit and tacit knowledge. Explicit knowledge can be described as the knowledge that can easily be transferred through written communication and spoken words. According to Polanyi (1966), tacit knowledge, on the other hand, resides in skills, experience and human beliefs and values.

Various scholars elaborate on the nature of tacit knowledge by including gut feelings, intuitions, insights, hunches and expertise (Jashapara, 2004; Al-Busaidi & Olfman, 2005; King, 2007; Liyanage et al., 2009). Tacit knowledge is difficult to communicate and requires different transfer mechanisms such as mentoring and shadowing (Polanyi, 1966; Nonaka & Takeuchi, 1995; Nickols, 2000). Tacit knowledge is content-specific and derives from years of accumulative personal experience (Inkpen, 2000; Foos, Schum & Rothenberg, 2006). According to Chen and McQueen (2010), there must be very close and extensive personal contact between individuals for tacit knowledge to be transferred successfully. Even though it is difficult to share, tacit knowledge is very important and valuable (Lam, 2000; Salmi & Torkkeli, 2009).

Knowledge has also been categorised as implicit, declarative, procedural, strategic, factual, propositional, theoretical, practical, experiential and personal (Nonaka & Takeuchi, 1995; Nickols, 2000; Boshoff, 2014b). This study concentrates on two sets of categories of knowledge, namely theoretical versus practical, on the one hand, and explicit versus tacit, on the other hand. Table 1.1 captures this study's description of the relationship between theoretical, practical, explicit and tacit knowledge.

Table 1.1: The relationship between theoretical, practical, explicit and tacit knowledge

Theoretical knowledge	**Practical knowledge**		
Know-what: scientifically created and validated	Know-how: based on previously encountered theoretical knowledge	Know-how: based on experiential learning	Know-how: based on personal experiential learning, values, beliefs, intuition, and gut feel
Codifiable	Codifiable	Can become codifiable	Non-codifiable
Easily communicated	Easily communicated	Generally, it can be communicated	Not easily communicated
Explicit	**Explicit**	**Can become explicit**	**Tacit**

In the context of this study, examples of explicit knowledge would be the scientific publications of oenology researchers, the plain language summarised articles written by oenology researchers for practitioners (winemakers) about their research outcomes, and technical presentations given by researchers or intermediaries at wine industry seminars, as well as usage guidelines from suppliers (intermediaries) for winemaking products used by winemakers. An example of tacit knowledge in the context of this study would be a winemaker judging the quality of a wine by just tasting it.

1.3 THE ECONOMICS OF KNOWLEDGE PRODUCTION AT UNIVERSITIES

Knowledge can be produced by universities, research institutions, private firms, organisations and individuals. Universities, however, are considered the focal point in producing theoretical, scientific knowledge. Knowledge production costs money, and in the latter part of the twentieth century, various factors have contributed to universities forming new funding alliances with government and private industries (Jacobson, Butterill & Goering, 2004a). One of the factors is the massification of higher education, which led to increased university research in Western countries and increased research costs (Geuna & Muscio, 2009). At the same time, many Western countries experienced a decrease in government (public) support for research, which increased the funding shortfall even further (Ylijoki, Lyytinen & Marttila, 2011). Fortunately, increased globalisation and the pressure on industries to innovate led them to look increasingly towards universities for knowledge production (Hessels & Van Lente, 2008).

As a result of these factors and more, many universities have developed a 'third mission' to generate third-stream income from private institutions, firms and industries to support the increased research capacity and supplement public funding (Geuna & Muscio, 2009; Perkmann et al., 2013).

It is reported that private funding can influence how knowledge is produced at universities to meet funders' expectations. There has also been policy and public pressure for increased accountability of universities to the public, resulting in the rise of knowledge production in the application context (Jacobson, Butterill & Goering, 2004a).

The knowledge production part of the literature study of this dissertation (see Chapter 2, section 2.3) discusses the changing nature of scientific knowledge production because of private funding and increased public accountability.

1.4 KNOWLEDGE TRANSFER

Reviewing the literature on knowledge transfer can be challenging. There are many facets to knowledge transfer and thus many possible definitions and terminologies. For instance, it depends on who is transferring the knowledge and to whom; whether the transfer is unidirectional (formal) or an exchange (dialogue, participatory, interactive); and whether the knowledge is explicit or tacit. Kumar and Ganesh (2009, p. 163) define knowledge transfer as "a process of exchange of explicit or tacit knowledge between two agents, during which one receives and uses the knowledge provided by another".

In addition to the many definitions existing in the literature, De Wit-de Vries, Dolfsma, Van der Windt, and Gerkema (2018) also noted little consistency in the terminology used. Knowledge transfer also does not necessarily represent a separate process from knowledge production. Knowledge transfer (as part of broader knowledge exchange) can also occur during knowledge production, as is typically the case in collaborative and contract research (Perkmann et al., 2013).

Another confusing situation is that ‘technology transfer’ and ‘knowledge transfer’ are often used interchangeably. According to Battistella et al. (2016), knowledge transfer can be separate from technology transfer in that knowledge transfer can be the transfer of a concept or competence without the involvement of a technological product or process. The opposite is not possible. Physical technology cannot be used without knowing how to use it (Bozeman, 2000).

In this study, knowledge transfer and technology transfer are two different concepts. Knowledge transfer is an action that can happen on its own, but technology transfer is a combination of the transfer of a physical product, process or technology and the knowledge on how to use it. An example of technology transfer is the commercialisation of university research results that resulted in patented products or processes.

The knowledge transfer part of the literature study (see Chapter 2, section 2.5) discusses researchers transferring knowledge to predominantly other researchers (scientific communication). A specific focus is placed on publication in scientific journals because of their importance in the evaluation systems of the academic community. Despite increased societal expectations for researchers to engage with non-academic audiences, the rewards and priorities of universities reflect the enduring value of more traditional academic activities, such as scientific publications. For researchers, this can lead to an uncomfortable disjunction between societal expectations and the persistence of university discipline-based criteria for reward and advancement (Jacobson, Butterill & Goering, 2004a).

The purpose of the knowledge production and knowledge transfer parts of the literature study is to provide insights into the internal operations of the academic community in general. It gives a background for the empirical study exploring the internal operations and external relations of oenology researchers of the Department of Viticulture and Oenology of Stellenbosch University, South Africa, who form part of this global academic community.

1.5 KNOWLEDGE UTILISATION

Knowledge utilisation can only happen after effective knowledge transfer took place. Knowledge utilisation can be conceptualised as a process or as different types. Landry, Amara and Lamari (2001) describe knowledge utilisation as a six-stage process. These stages are transmission, cognition, reference, effort, influence and application. The first stage, the transmission of knowledge, is not utilisation, but it is included in their process since the following five steps are conditional upon it. Utilisation starts during the cognition phase when potential users engage with the transmitted knowledge, and ideas and insights start to form in their minds (Boshoff, 2014a). The final stage of application is when users have changed their practices because of the new knowledge received.

According to Boshoff (2014a), knowledge utilisation can also be described as a type, the way knowledge is used, and various 'typologies' or 'models' exist in the literature (Weiss, 1978; Estabrooks, 1999). A comprehensive overview of these models falls outside the scope of this study, but one model is very applicable to this study, namely the enlightenment model as described by Weiss (1978). According to Weiss, people store new research results with all the other knowledge already in their minds. They do not categorise information separately. It is, therefore, difficult or impossible for people to identify the unique contribution that one, or a group of studies, or research in general, made to their actions. Weiss also refers to this as "knowledge creep", which in the context of policy studies is the "diffuse, undirected seepage of social research into the policy sphere" (Weiss, 1978, p. 23).

In the final part of the literature study of Chapter 3, a discussion is provided on the knowledge utilisation of practitioners more generally. It also focuses on knowledge utilisation by winemaker practitioners and, specifically their information-seeking behaviours, narrowing the focus of the literature study to provide a background on the winemaker community.

1.6 AIM AND METHODOLOGY OF THE STUDY

Winemaking-related boundary-spanning activities focused on oenology researchers and winemakers in the South African wine industry were empirically investigated. They include:

- Collaborative and contract academic research with industry (Perkmann et al., 2013)
- Unidirectional and interactive knowledge transfer channels (Boshoff, 2014a; Szymanski & Davis, 2015; Dippenaar, 2017)
- The role of intermediaries in effective knowledge transfer and utilisation (Boshoff, 2012; Dippenaar, 2017)

The empirical study is supported by a comprehensive literature review providing background information on the researcher and winemaker communities. It builds on a previous study by Boshoff (2012) in the South African wine industry. However, Boshoff studied only the winemaker and intermediary community, not the academic community. In the light of the above, the current study was guided by four research questions:

1. What are the current internal operations and external relations of science?
2. What are the internal operations and external relations of the community of South African oenology researchers specifically?
3. What factors and conditions characterise the institutional landscape and information-seeking behaviours of South African winemakers and intermediaries (e.g., oenological consultants and suppliers of related products and services to the industry)?
4. Based on research questions 1 to 3, what can be concluded about boundary-spanning activities as ways to strengthen knowledge exchange and practice adoption within the South African wine industry? (Evidence-based recommendations for boundary-spanning knowledge exchange between oenology researchers and winemakers.)

A mixed-method research design was used to study the case of winemaking-related knowledge interactions involving academic researchers, winemakers and intermediaries. This was done by employing both quantitative and qualitative research methods – a web survey, semi-structured interviews and documentary analyses – thereby allowing for comprehensive insights to be gained. In addition to the three empirical study components, non-empirical components include a literature study (Chapter 2) and recommendations to improve knowledge exchange between wine scientists and winemakers (Chapter 7). Table 1.2 below shows the alignment between the research questions and the empirical and non-empirical study components.

Table 1.2: The alignment between the research questions and the empirical and non-empirical study components

Research questions	Study components
What are the current internal operations and external relations of science?	Review of academic literature
What are South African wine scientists' internal operations and external relations, specifically?	Documentary analysis of practices (research appraisal, funding, etc.) at the DVO and Stellenbosch University Semi-structured interviews with 11 oenology researchers
What factors and conditions characterise South African winemakers' institutional landscape and information-seeking behaviours?	Documentary analysis of structures and initiatives of the South African wine industry A web survey of South African winemakers Semi-structured interviews with 20 winemakers and ten intermediaries
What can be concluded about the identified boundary-spanning activities as ways to strengthen knowledge transfer and uptake within the South African wine industry?	Recommendations to improve knowledge exchange between oenology researchers, winemakers and intermediaries

1.7 OUTLINE OF THESIS

The thesis is structured as follows:

Chapter 2 ("Internal operations and external relations of science") discusses the production of scientific knowledge and how it is perceived to have changed from the Second World War until today. Specific emphasis is placed on the role of society in determining the research agenda and its outcomes. Scientific publication, which plays an important role in researcher and university evaluation systems, is discussed to provide insight into the world of the researcher community.

The first part of Chapter 3 ("The South African wine industry and the knowledge uptake of wine industry practitioners") discusses the various actors in the South African wine industry involved in scientific knowledge production and its dissemination. The second part of Chapter 3 discusses the information-seeking behaviours of practitioners in general, followed by a discussion of studies related to winemaking specifically to provide insight into the world of the winemaker community.

Chapter 4 ("Research design and methodology") discusses the specific research methods, selection of participants, and general procedures followed in obtaining the data for the empirical study.

Chapter 5 (“Factors that influence the knowledge transfer activities of South African oenology researchers”) presents the results obtained from semi-structured interviews with oenology researchers. It demonstrates the internal operations and external relations of a specific scientific community and how this community relates to a particular industry community (South African winemakers). Emphasis is placed on the boundary-spanning activities mentioned in the aim and methodology of this chapter. The common thread throughout the chapter is how the researchers balance excellence with relevance.

Chapter 6 (“Information seeking behaviours of South African winemakers and intermediaries”) presents the results from a web survey and semi-structured interviews with winemakers. The results from semi-structured interviews with intermediaries are also presented.

Chapter 7 (“Discussion and Conclusions”) discusses the results from the empirical study and compares it with the literature cited in Chapters 2 and 3. It also discusses the boundary-spanning activities between the DVO oenology researchers and SA winemaker communities specifically. The thesis concludes by proposing improvements to several boundary-spanning activities between the two communities.

CHAPTER 2: INTERNAL OPERATIONS AND EXTERNAL RELATIONS OF SCIENCE

2.1 INTRODUCTION

Researchers and users operate in two different 'worlds' as described in Caplan's 'two communities' theory (1979). The fact that they speak different 'languages' and are exposed to different evaluation systems can be a barrier to effective knowledge exchange between them. The purpose of this chapter is to provide insight into the world of the academic community. It gives a background to the empirical study of the internal operations (knowledge production and scientific communication within academia) and external relations (academic engagement with non-academic stakeholders) of oenology researchers in this dissertation.

The first four parts of this chapter describe academic knowledge production and how it has evolved to address societal needs. It starts with scholarly perspectives on scientific research followed by various theses, frameworks or models that describe the changing nature of scientific knowledge production. A relatively recent framework, academic engagement by Perkmann et al. (2013, 2021), is elaborated upon. The fifth part of the chapter describes various aspects of scientific publication in peer-reviewed journals, given the importance of scientific publishing in the academic evaluation system and the influence it can have on researchers' external relations (propensity to engage with non-academic audiences).

2.2 SCHOLARLY PERSPECTIVES ON SCIENTIFIC RESEARCH

2.2.1 NORMS OF SCIENTIFIC RESEARCH

Academic science is a distinct human culture with certain practices, traditions, conventions and rules (Ziman, 1996a). In 1942, an American sociologist, Robert K. Merton, first described the norms (or ethos as it was called during that time) that were associated with doing and communicating science (Weingart, 2003). Even though these Mertonian norms of communism, universalism, disinterestedness and organised scepticism (CUDOS) were conceived in a specific historical situation during the second world war, it was accepted as the basis for empirical sociology of science for many years (Merton, 1968a; Etzkowitz & Leydesdorff, 2000).

The norm of communism, which Ziman later refers to as communalism (Ziman, 1996b, a) and Weingart as communality (Weingart, 1997), refers to the fact that science should be a product of social collaboration and that the results generated should be regarded as public knowledge. Universalism requires that scientific contributions not be excluded based on nationality, race, gender, social status or religion. Disinterestedness implies that scientists must only report the truth and resist the temptation to falsify data. In this way, they remain true to their peers. Organised scepticism refers to the systematic testing of research claims by scientists' peers, for example, today via the journal peer review system.

Commercialising academic knowledge that involves patenting and licensing inventions can sometimes challenge Merton's norms (Merton, 1968a). Here the communality norm, where scientific results should be shared, is challenged because publications are delayed or withheld entirely (Ylijoki, Lyytinen & Marttila, 2011). Private companies that fund research at public institutions do not want to distribute their results to competitors before reaping their economic benefits. Commercialisation is, however, only one outcome of privately funded research and forms a minority part of knowledge transfer activities of universities (Geuna & Muscio, 2009). Collaborative and contract research, and its accompanying knowledge exchange between researchers and practitioners, is practised by a far more significant proportion of academics than commercialisation (Perkmann et al., 2013). Boardman and Ponomariov (2009) believe that collaborative and contract research is not necessarily at odds with the Mertonian norms.

2.2.2 TYPES OF SCIENTIFIC RESEARCH

2.2.2.1 Basic versus applied research

Despite the criticism surrounding dividing research into only two types, basic and applied, this categorisation is still widely used by governmental and other funding agencies (Sapir, 2017). According to Calvert (2004) and Stokes (1997), research can be classified as basic or applied depending on the local, national and international settings and the time period it was conducted. Calvert (2004) also reports that researchers define whether a particular research project is basic or applied based on one or more of these criteria: the nature of the knowledge produced (epistemological), its aims and intentions, its distance from an application, the institution where it is produced, disclosure norms and field or discipline. Discipline cultures, for instance, span international boundaries and can influence what type of research is done within a specific scientific community (Bentley, Gulbrandsen & Kyvik, 2015).

The boundary between basic and applied research has been described as permeable, blurred and ambiguous, and critics claim that separating research into these two types oversimplifies the research process (Sapir, 2017; Ylijoki, Lyytinen & Marttila, 2011). The distinction nevertheless remains, and it can determine whether a research project will be funded or not.

In terms of the history of knowledge production, it is reported that basic research became firmly established in academic institutions, predominantly universities, after World War II (Calvert, 2004). Basic research was described as the highest expression of the Western scientific worldview. It was characterised by the autonomous pursuit of knowledge, free from any interference from government or society. Basic research was also in line with the scientific norms described by Merton (1968a). It was understood to feed technological innovation based on a linear model (as it became referred to later). It was legitimised by the United States presidential science advisor, Vannevar Bush, in his 1945 report: *Science: The Endless Frontier* (Calvert, 2004). In this report, Bush defines basic and applied research as:

"Basic research is performed without thought of practical ends. It results in general knowledge and an understanding of nature and its laws. This general knowledge provides the means of answering a large number of important practical problems, though it may not give a complete specific answer to any one of them. The function of applied research is to provide such complete answers." (Bush, 1945).

Basic research remained the most prominent form of research until the 1950s (Calvert, 2004). In 1963, the Frascati manual of the OECD[2] first introduced a boundary around basic research activities by creating an official definition for it to be able to measure it. This was also the time when science policy started to emerge.

The current Frascati manual defines basic research as follows:

"Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view." (OECD, 2015, p. 45).

The linear model, or the 'technology-push' model of knowledge production as it is also referred to in literature, saw the flow of knowledge from basic research to applied research to industrial development (Lam, 2007). University and industry operated as two separate institutional spheres in this model. The boundary-spanning mechanism that linked them was the recruitment of academic researchers by industry.

[2] Organisation for Economic Co-operation and Development

During the ’60s, government spending on research in most Western countries reduced, and the ’70s saw the rise of applied research and market-oriented approaches to research (Calvert, 2004). This was the start of the market-pull model of knowledge production (Lam, 2007). By the time the Cold War ended in the 80s, most research institutions had conducted basic and applied research.

The current Frascati manual defines applied research as:

“Applied research is an original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific, practical aim or objective.” (OECD, 2015, p. 45).

It seems that there are distinct differences between basic and applied research. The reality is that the boundary is very blurred. Calvert (2004, 2006) showed how scientists exploit the ambiguity of the definitions. To achieve funding, they can describe their research as applied. Similarly, they can make the study appear more basic to shield them from external bodies' demands of applicability and evaluation. Despite the ambiguity of the terms basic and applied, they remain in use simply because they can be used for statistical measurement (Godin, 2003).

Researchers tend to view basic research as very important, if not the most important type of research. It is unclear whether researchers perceive this importance because they are concerned with the future of the quality of science produced or if they are mostly concerned with their publication record and meeting academia’s evaluation criteria. Whilst applied research holds clear benefits for individual businesses or society, some scholars report it could harm academic output (David, 2004; Nelson, 2004; Geuna & Nesta, 2006). The opposite has also been said where increased industry funding to universities positively impacted academic output (Gulbrandsen & Smeby, 2005).

Some scholars report that there has been a definite shift from mainly doing basic research to doing more applied research and call this a “new production of knowledge” and a “second academic revolution” (Gibbons et al., 1994; Etzkowitz & Leydesdorff, 2000, p. 110). The first revolution happened when research was introduced together with teaching in the early nineteenth century as the second core function of universities. Other scholars argue that basic and applied research have co-existed for centuries and that there is nothing new about the latter type (Ziman, 1996a; Martin & Etzkowitz, 2000; Geuna & Muscio, 2009; Rossi, 2010).

2.2.2.2 Research in Stokes’ four quadrants

In 1997 Donald Stokes challenged the traditional approach of classifying research only as basic or applied, as well as the view that knowledge creation to an application is a unidirectional flow (Stokes, 1997). According to him, basic scientific research projects can often have dual motivations, and he suggested the “quadrant model of scientific research” (Stokes, 1997, p.73). In this model, the first quadrant, Bohr’s quadrant (named after Niels Bohr, a 20^{th}-century physicist), represents pure basic research. Edison’s quadrant, named after the 19^{th}-century inventor and entrepreneur, represents pure applied research. He then introduced Pasteur’s quadrant, named after Louis Pasteur, a 19^{th}-century chemist and microbiologist, representing use-inspired basic research. Pasteur’s quadrant allows for the classification of research with orientations towards both a fundamental understanding and consideration for use. Figure 2.1 demonstrates the quadrant model of scientific research.

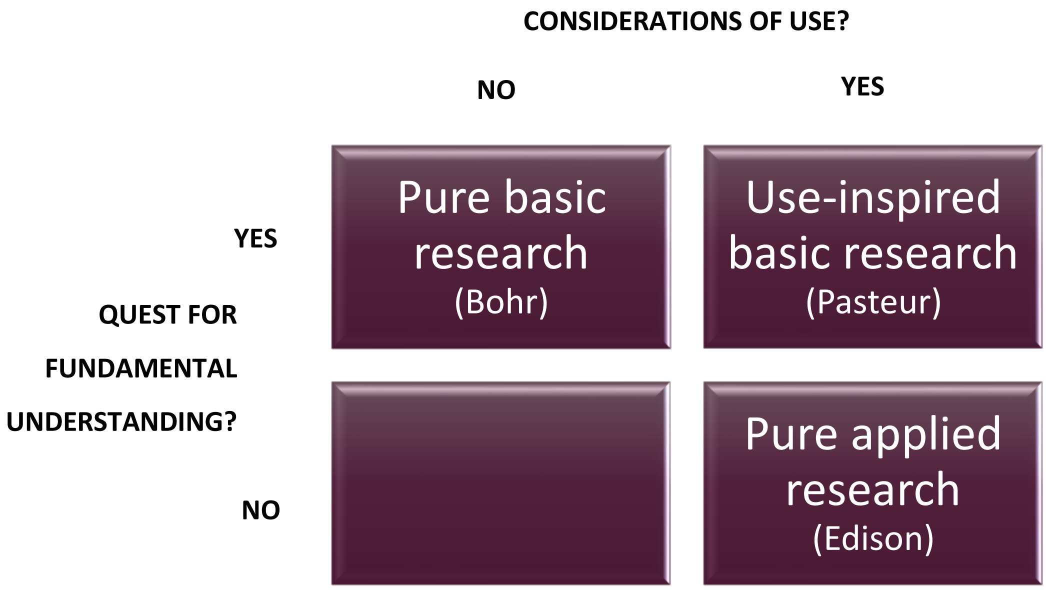

Figure 2.1: Stokes's quadrant model of scientific research
Source: Stokes, 1997, p.73

Stokes did not argue that all researchers must aspire to do Pasteur’s quadrant research (Klahr, 2019). Nor did he suggest that public funding should benefit Pasteur’s quadrant over pure basic or applied research. Stokes used his model to explain that science is more complex than the dichotomy of basic versus applied and that such a narrow classification system misrepresents important aspects of scientific research.

Since the publication of Pasteur’s Quadrant by Stokes, researchers have also used the model to try and classify individual scientists according to their research orientation and performance. However, according to Tijssen (2018), Stokes’ two-dimensional framework, although adequate to describe research, is inadequate to capture key characteristics of individual researchers. He proposed Pasteur’s Cube as a three-dimensional conceptual framework to describe the research-related activities of academics at research-intensive universities. This framework captures the use-inspired identity of researchers by measuring concrete outputs and impacts rather than focusing on motivational factors and self-classification. The Pasteur's Cube model comprises three observable dimensions:

- Knowledge production and skills creation
- Technological development and artefacts production
- End-user engagement

Tijssen (2018, p. 1630) defines end-user engagement as:

"Responses and interactions with users, often outside the academic research community, with regards to the dissemination, utilisation or commercialisation of research-based knowledge, artefacts or skills where an 'end user' is defined as an individual, community or organisation external to academia that will directly use or directly benefit from the output, outcome or result of the research."

Pasteur's Cube identifies three distinct researcher archetypes: science-oriented, application-oriented and user-oriented, as well as a fourth group, crossover researchers, that combine the three research orientations of Pasteur's quadrant. Figure 2.2 is a graphical representation of Pasteur's Cube.

This model is relevant to the classification of oenology researchers explored in the empirical part of this dissertation.

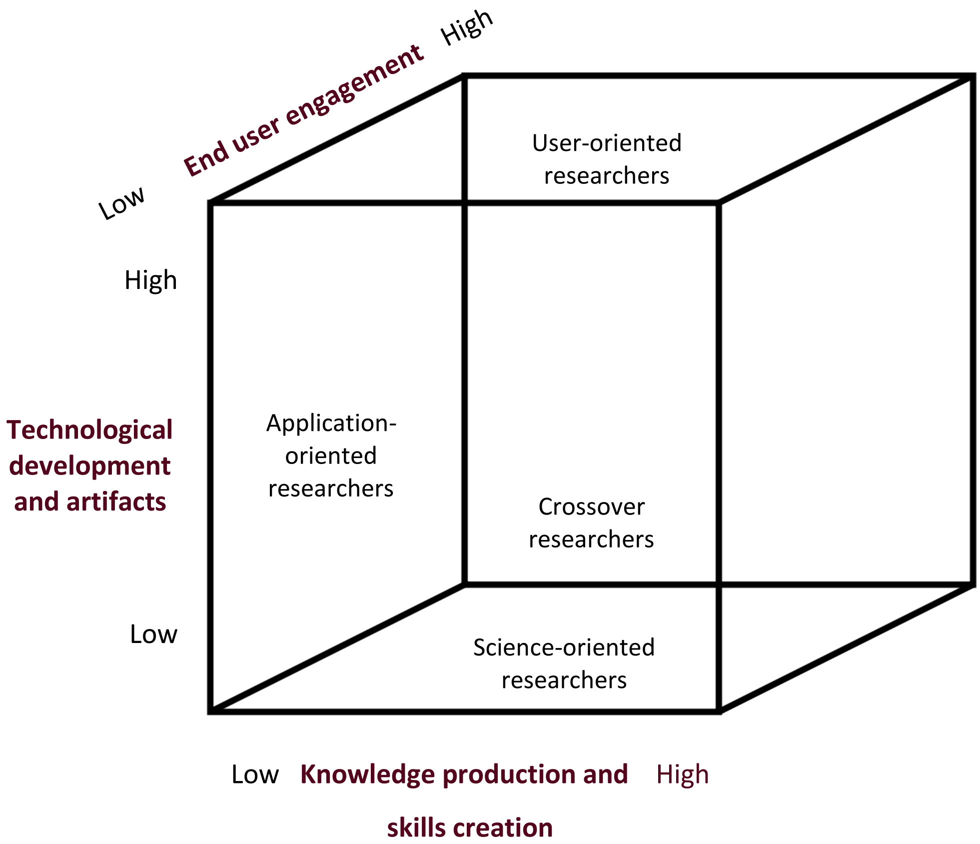

Figure 2.2: Pasteur's Cube model depicting researcher types
Source: Tijssen, 2018, p. 1632

2.2.2.3 Research typology that incorporates public value

According to McNie, Parris and Sarewitz (2016), the standard categorising of research, i.e., basic or applied and Stokes' quadrant research model, do not consider the role of research users. They proposed a multi-dimensional typology that can be used as either a prescriptive or descriptive tool in designing and evaluating research projects or programmes. The typology describes three activities and 15 related attributes. The three activities are knowledge production, learning and engagement, and organisational and institutional processes. The idealised attributes are expressed on a spectrum ranging from strongly science-centric to strongly user-oriented. A detailed description of all 15 attributes falls outside the scope of this dissertation. Table 2.1 demonstrates the authors' typology of research activities and attributes.

Table 2.1: Typology of research activities and attributes

Activity	Attribute	Spectra of research criteria Science values	 User values
Knowledge production	Expertise	Epistemic	Experiential
	Relevance	General	Contextual
	Disciplinary focus	Singular, narrow	Transdisciplinary, diverse
	Uncertainty	Reduce uncertainty	Manage uncertainty
	Goals for research	Exploratory	Outcome oriented
Learning and engagement	Learning	Theoretical	Social, practical
	Knowledge exchange	Restricted, linear	Iterative, influential
	Network participation	Homogenous	Heterogeneous
	Social capital	Negligible	Significant
Organisational & institutional processes	Accessibility	Constrained	High
	Outputs	Narrow	Diverse
	Evaluation & effectiveness	Science-centric	Public-value oriented
	Flexibility	Constrained	Responsive
	Human capital	Narrow	Broad
	Boundary management	Limited	Broad

Source: McNie, Parris & Sarewitz, 2016, p. 887

According to the researchers who conceptualised this typology, it can help evaluate existing projects and programmes and completed projects in terms of achieving their goals. It can also improve science-policy decisions and planning.

The next section of the literature study describes the different frameworks, theses and models proposed during the past four decades to describe the shift to research that includes public value. The most widely referred to model depicting the transformation of knowledge production is *The New Production of Knowledge* and the Mode 2 thesis (Gibbons et al., 1994). There are various alternative accounts of changes in knowledge production, and the Mode 2 thesis was not the first account. These accounts include finalisation science (Bohme et al., 1983), strategic science (Irvine & Martin, 1984;

Rip, 2002), post-normal science (Funtowicz & Ravetz, 1993), post-academic science (Ziman, 1996a), academic capitalism (Slaughter & Leslie, 1997), Triple-Helix (Etzkowitz & Leydesdorff, 1998), engaged scholarship (Van de Ven & Johnson, 2006) and academic engagement (Perkmann et al., 2013). All these models have one concept in common: the societal relevance of research is becoming increasingly important.

Thus, the following section gives a brief overview of the above-mentioned theses, models and frameworks of knowledge production that provide different perspectives on the externalisation of scientific knowledge production. The order is chronological, as presented in the review of Hessels and Van Lente (2008). In contrast to their review, the Mode 2 thesis does not form the centre of this discussion. It is important to keep in mind the historical settings and fields of research on which these scholars based their models and theses.

2.3 SCHOLARLY PERSPECTIVES ON THE EXTERNALISATION OF SCIENTIFIC KNOWLEDGE PRODUCTION

2.3.1 FINALISATION SCIENCE

A group of scholars called the Starnbergers conducted studies during the 1970s on the dynamics of different science disciplines (Bohme et al., 1983). They developed the concept of 'finalisation science' where they claim each discipline follows a linear pathway towards theoretical maturity (Hessels & Van Lente, 2008). According to them, there are three development phases: an explorative phase, a paradigmatic phase and a post-paradigmatic phase. During the post-paradigmatic phase, "finalisation" can occur, which is determined by external factors. Further theoretical development then happens per the objectives of these external factors.

An example to explain this concept within the discipline of microbiology would be the study of the nitrogen utilisation of the model yeast, *Saccharomyces cerevisiae*. In the explorative phase, researchers will try to establish which nitrogen sources are preferred by the yeast, what they are used for and what genes are involved in regulating this utilisation. All the research will be conducted in a laboratory using *in vitro* techniques on a very small scale. During the paradigmatic phase, one of the practical uses of this model yeast, i.e., winemaking, can serve as background for the research. During this phase, researchers investigate how *Saccharomyces cerevisiae* wine yeasts utilise nitrogen sources typically found in grape juice. Experimentation is still in the laboratory, on a small scale in synthetic grape must where all variables are strictly controlled. Once all the variables have been explored and documented, the project has reached theoretical maturity. In the next post-paradigmatic phase, researchers observe what happens in practice. During this "finalisation" phase, winemakers get involved, sharing their practical experiences, and experimental design then includes knowledge obtained from these practical experiences. Experiments are conducted using real grape must in a semi-industrial set-up (experimental winery) but are still executed according to the scientific method.

Böhme et al. (1983) concluded that more and more disciplines reach this phase, implying that society has become an active partner in the research agenda.

The finalisation concept is based on strong empirical evidence. It is different from some of the other later theses because it views research as a linear process ('technology-push model') from where it is conceptualised to where it becomes socially relevant. The process is also primarily internally driven until the finalisation step. The Starnbergers were also prescriptive in their policy recommendations regarding the involvement of society in the finalisation phase.

The finalisation thesis was negatively received by both scientists and policymakers at the time because of its real or imagined implications for the public legitimisation of science and science policy (Weingart, 1997). It was viewed as a threat to the autonomy of science by many.

To conclude: The finalisation thesis was based on empirical evidence from various disciplines. It viewed knowledge production as a linear process, with society only becoming involved in the final stage (Mouton, 2001).

2.3.2 STRATEGIC SCIENCE

Irvin and Martin (1984, p.4) first defined strategic research in a policy study as:

"Basic research carried out with the expectation that it will produce a broad base of knowledge likely to form the background to the solution of recognised current or future practical problems."

So, researchers still have the academic freedom to pursue the most promising line of research but must consider the relevance of their work (Hessels & Van Lente, 2008). Or the research can be directed by broad national or economic objectives of a country to which it can contribute (Mouton, 2001). It still leaves the choice of research direction to the research system's social control mechanisms.

Rip (2002) elaborated on the concept by describing strategic science as research that combined excellence and relevance. With strategic science, there is still a distance between the research and its eventual uptake, with the research only contributing to a reservoir of scientific knowledge from which other scientists can 'fish to create new combinations.' The innovation chain is thus not linear but somewhat lateral, with the possibility of more exciting innovations other than the linear expectation of immediate societal benefits.

Using the previous example of the study of the nitrogen utilisation of the model yeast *Saccharomyces cerevisiae*, the reservoir of knowledge created can also be used as a base for entirely different applications than wine, e.g., the bio-pharmaceutical production of insulin and various vaccines (Nielsen, 2013), as well as synthetic biology (Pretorius & Boeke, 2018).

Rip (2002) also stressed the importance of strategic research in regional innovation systems. He acknowledged the challenge of creating an effective combination of the local (relevance) and the global (excellence). He further argued that this combination of excellence and relevance is not present in all scientific fields and disciplines in the same way but does occur enough to justify strategic science as a realistic category.

To conclude: Strategic science was a concept introduced and later elaborated upon in policy studies. In contrast to Finalisation science, it views the research process as lateral. It also does not necessarily involve society, other than the topic should be relevant to society.

2.3.3 POST-NORMAL SCIENCE

The concept of post-normal science was introduced by Funtowicz and Ravetz (1993) and referred specifically to policy-relevant scientific fields with uncertain facts, disputable values, high stakes and in need of urgent decisions. It is mainly related to policy issues of risk and the environment, which are critical problems for science and where managing quality and uncertainty is crucial. Funtowicz and Ravetz defined post-normal science as 'issue-driven' compared to applied science being 'mission-oriented,' professional consultancy being 'client-oriented'" and basic research being 'curiosity-motivated.'

Post-normal science is distinguished from the previous models discussed in that it actively engages society (stakeholders) in the decision-making processes or the quality assessment of the scientific knowledge produced (Hessels & Van Lente, 2008). According to Funtowicz and Ravetz (1993), this "extended peer community" positively enriches the scientific investigation because of their practical knowledge, which scientists often lack. The additional quality criteria obtained by extended peer communities and the resulting extension of facts are necessary for science to meet the challenges of global environmental problems, such as climate change. Post-normal science is also the first model discussed here that involves interaction across disciplines and organisational boundaries (Hessels & Van Lente, 2008).

To conclude: post-normal science also refers to policy-related research (albeit more urgent on a national, regional or global scale), as is the case with strategic science. It also involves society in the research process like finalisation science but differs from the latter in that society in the form of specific stakeholders are engaged throughout the research process and not just in the final stages.

2.3.4 MODE 2 SCIENCE

The Mode 2 thesis was first described in a book: *The New Production of Knowledge* (Gibbons et al., 1994), by six scholars in the field of policy studies. The authors describe Mode 2 knowledge production as socially distributed, application orientated, trans-disciplinary and subject to multiple accountabilities.

Mode 2 research is not confined to traditional universities but can include institutes, research centres, industrial labs, governments, high-tech spin-off companies and consultancies (Hessels & Van Lente, 2008). As a result, there is also a more comprehensive range of non-scientific partners involved and greater emphasis is placed on the research's potential application and social consequences. The research is a dialogic process that can include multiple views and novel forms of quality control outside of the traditional peer-review process.

In contrast, Mode 1 is the traditional way of doing research in an internally driven taxonomy of disciplines and by the autonomy of scientists and universities – their host institutions (Nowotny, Scott & Gibbons, 2003). Mode 1 knowledge production can also result in practical applications and often do, but practical application is not a pre-requisite at the onset of the research. Mode 2 research which is gradually becoming more and more dominant, is not believed to replace Mode 1 but rather to supplement it.

Mode 2 knowledge production received widespread criticism, both positive and negative. Some of the negative criticisms received include the lack of empirical evidence and generalisation of the thesis. Weingart (1997) argues that Mode 2 knowledge production pertains mainly to an area of science close to policymaking. Godin (1998) agrees and argues that social science and humanities have always been Mode 2, but that it's not the case for natural and physical sciences.

As a reaction to some of the criticisms, three of the authors published a second book - *Re-thinking Science: Knowledge and the Public in an Age of Uncertainty* (Nowotny, Scott & Gibbons, 2001). The same three authors also published a paper: *"Mode 2" Revisited: The New Production of Knowledge* (Nowotny, Scott & Gibbons, 2003) in a special issue of the journal *Minerva*, further clarifying their claims in their original book. To them, the idea of Mode 2 was never to become a 'new-fangled label' for applied science or programmatic research, and it was not intended to be an empirical study. The books aimed to identify the key changes in the relationship between science and society.

Mode 2 remains a highly cited concept (Hessels & Van Lente, 2008). In most publications, Mode 2 is only used to sketch the background of the research being reported, to help design a theoretical framework from which research questions are formulated, or to discuss implications of findings, i.e., it is used as a rhetorical device.

To conclude: The Mode 2 knowledge production thesis was not based on empirical evidence and, as a result, was heavily criticised. The concept involves research conducted in the 'context of application' and includes research generating role-players other than academia.

2.3.5 POST-ACADEMIC SCIENCE

In 1996, Ziman, a theoretical physicist, introduced post-academic science (Ziman, 1996b, a). He later elaborated on the concept in a book: *Real Science: What it is and what it means* (Ziman, 2000). Ziman's approach to the changes in academic knowledge production is primarily descriptive with a very loose empirical foundation, similar to the Mode 2 thesis (Hessels & Van Lente, 2008). According to Ziman (1996b, a), academic knowledge production is changing rapidly because of societal forces pressing it. Governments are putting strict financial ceilings on their research budgets because the research enterprise is becoming too large and too expensive to be allowed to be autonomous. Ziman argues that with this 'steady state' also comes strict requirements which are incompatible with science's original norms, as described by Merton. Ziman introduced a new set of norms which he labelled as PLACE: Proprietary, Local, Authoritarian, Commissioned and Expert.

"It produces *proprietary* knowledge that is not necessarily made public. It is focused on *local* technical problems rather than on general understanding. Industrial researchers act under managerial *authority* rather than as an individual. Their research is *commissioned* to achieve practical goals, rather than undertaken in the pursuit of knowledge. They are employed as *expert* problem solvers, rather than for their personal creativity" (Ziman, 2000, pp 78-79).

Post-academic science requires an increasing need for accountability and efficiency, and both government and society require a faster diffusion rate of research results. Ziman also described an increase in the transdisciplinary nature of knowledge production.

To conclude: There is very little difference between post-academic science (post-industrial science, used interchangeably by Ziman) and the Mode 2 thesis. The Mode 2 thesis, however, advocates the co-existence of Mode 1 and Mode 2 research, whereas Ziman postulates that post-academic science will eventually replace traditional (basic / Mode 1) research.

2.3.6 ACADEMIC CAPITALISM

Academic capitalism, conceptualised by Slaughter and Leslie (1997), discusses the increased market orientation of universities. It refers to the attraction of external (third stream) funding at all higher education levels. It includes funding for for-profit activities such as patenting, licensing and spin-off companies, as well as non-profit activities such as research grants, research contracts, donations and student tuition and fees. Universities, departments, research groups and individual researchers compete for this external funding.

According to the authors, the rise of the entrepreneurial university is attributed to public money to universities receding, as well as increasing globalisation that forces industries to innovate. As a result, industries are looking more and more to universities for innovation.

Slaughter and Leslie (1997) argue that the growing market orientation is advantageous for those disciplines close to the market. For disciplines further from the market, where it is more difficult to generate results that can be commercialised, it will be more challenging to attract funding from outside traditional academic funding bodies.

On an individual level, Ylijoki et al. (2011) observed that academic capitalism seems to have a 'Matthew effect' (Merton, 1968b) in that it benefits more senior researchers who have established academic standings and established positions at the university. Ylijoki et al. (2011) conducted a study amongst Finnish academics to empirically investigate the changing nature of academic knowledge production from a traditional academic orientation to a market orientation, based on the academic capitalism thesis. They analysed survey data containing information on research topics, collaborations, audiences and method of publication. They specifically focused on discipline differences. Their study had various conclusions. Firstly, the academic orientation of research remains crucial in all disciplines investigated. Secondly, 'market orientation' entails multiple markets: academic, corporate, policy, professional and public. Each market has different objectives and expectations of research outcomes. However, this categorisation is not absolute and there are constant crossings and negotiations across markets. Based on their results, the authors concluded that the notion of universities transforming from a traditional academic orientation to a market orientation needs to be revisited.

To conclude: The concept of academic capitalism was criticised for lack of conceptual clarity and empirical evidence. Some scholars felt that academic and market orientations have always existed in universities and that it was a shift in the balance toward market orientation rather than the emergence of something new (Martin & Etzkowitz, 2000).

2.3.7 TRIPLE HELIX

The Triple-Helix thesis (Etzkowitz & Leydesdorff, 1998, 2000; Etzkowitz et al., 2000) is based on the interdependent relationship between the university, government and industry, as illustrated by three overlapping spheres (Figure 2.3). According to this model (as with some of the previous ones discussed), the linear scientific knowledge production and utilisation model is replaced by new organisational mechanisms. The authors refer to the third mission of universities in addition to research and teaching, where the universities undertake entrepreneurial activities to enhance regional or national economic performance and their own financial income. Entrepreneurial activities are not confined to licensing and patenting but can extend to under- and post-graduate training. In the Triple Helix Model, the distance between institutional spheres is reduced because of a two-way influence flow between the university and an increasingly knowledge-based society.

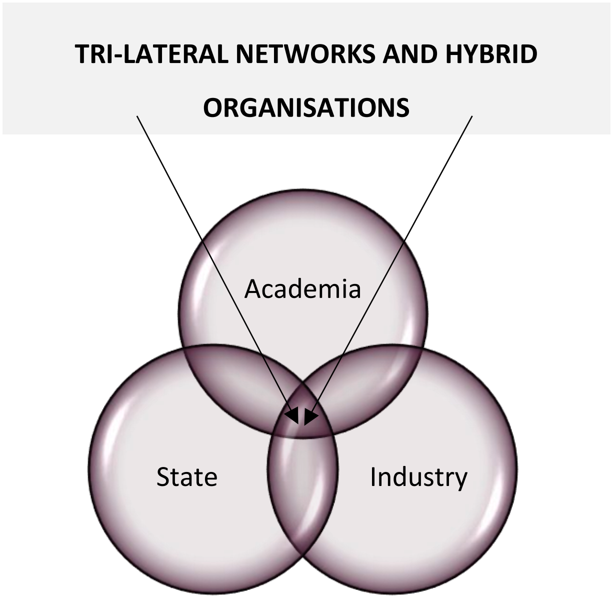

Figure 2.3: The Triple Helix Model of University-Industry-Government Relations
Source: Etzkowitz & Leydesdorff, 2000, p. 111

Four processes related to knowledge production and exchange have been identified in the Triple Helix model (Etzkowitz et al., 2000). Firstly, there is an internal transformation of each helix, for instance, the assumption of a third mission in the case of universities. Secondly is the influence of one institutional sphere on another, for example, the revision of intellectual property rights by governments for public-funded research. An example is the passing of the Bayh-Dole Act of 1980 in the United States, which allows universities the intellectual property rights of government-funded research (Perkmann et al., 2013). As a result, there have been important modifications to universities' policy environments. Thirdly is the creation of trilateral networks that encourage interaction between the members of the three spheres, leading to innovative ideas and joint ventures. Fourthly is the effect of these inter-institutional networks on their originating spheres and society. One example is the capitalisation of knowledge taking increasing precedence over the disinterestedness norm of science (Merton, 1968a; Etzkowitz et al., 2000). The latter is evident in the establishment of dedicated technology transfer offices (TTOs) in universities. Government grants also increasingly require scientists to evaluate their research for technological and economic potential.

To conclude: The Triple Helix model sees the current knowledge infrastructure as a mix of Mode 1 and Mode 2 research and disagrees with the concept that Mode 1 was the original form of research (Hessels & Van Lente, 2008).

2.3.8 ENGAGED SCHOLARSHIP

Three reasons are given in the literature for the perceived gap between knowledge created by academia (theory) and knowledge required by practitioners (practice) (Van de Ven & Johnson, 2006). Firstly, it is seen as a knowledge transfer problem. Secondly, theoretical and practical knowledge is seen as two distinctly different types of knowledge, not necessarily in opposition, but complementary to each other. Thirdly, the gap is seen because of a knowledge production problem. Van de Ven and Johnson (2006) address the third approach of 'a knowledge production problem' and propose the model of "engaged scholarship" to narrow the gap between theory and practice. The scholars define engaged scholarship as:

"A collaborative form of inquiry in which academics and practitioners leverage their different perspectives and competencies to co-produce knowledge about a complex problem or phenomenon that exists under conditions of uncertainty found in the world" (p. 803).

Van de Ven and Johnson (2006) base engaged scholarship on the concept of arbitrage. Examples of collaboration that fosters arbitrage include research teams, research review panels and advisory boards made up of researchers and practitioners. Because arbitrage is a dialectal process, there will invariably be conflict because of pluralistic views of a given reality. The central challenge in engaged scholarship is effective and creative conflict management between researchers and practitioners.

The authors provide five strategies for engaged scholarship. The first is to design projects that address big problems or questions grounded in reality. Big problems require academics to reach out to other scholars in other disciplines and practitioners since the questions exceed academics' individual abilities. Engaging with practitioners also gives academics better ideas of these big problems or questions.

Secondly, a research project must be designed in such a way that it is a collaborative learning community. The research must be designed, conducted and implemented in real-world settings. Diverse perspectives from outside the traditional discipline can be integrated to provide a rich and robust research question, design and analysis.

Thirdly, studies must be designed for extended durations. The longer the researchers spend time being submerged in the practical aspects of the phenomenon they are studying, the bigger the chance of the project making a scholarly contribution. Vice versa, the longer practitioners spend time involved in research, the greater the chance of them adopting the outcomes.

Fourthly, multiple models and methods must be employed to study the problem. Comparing more than one plausible explanation for the phenomenon being investigated increases reliability and validity, as well as the likelihood of making significant knowledge advancements for both theory and practice.

Lastly, assumptions about scholarship and the roles of researchers must be re-examined. The specific role a researcher will play in a collaborative research environment will be influenced by their preferences and training, as well as the nature of the phenomenon being investigated. They can either be detached observers (as is often the case in social sciences) or change agents helping a client solve a problem.

Van de Ven and Johnson (2006) adopt the perspective that engaged scholarship not only enhances the relevance of research but also advances research knowledge in a discipline. Engaged scholarship, therefore, does not imply that researchers should engage more in applied research; on the contrary, the arbitrage strategy surpasses the dual hurdles of rigour and relevance in the conduct of fundamental research relating to complex problems in the world.

Challenging the extent of engaged scholarship (Van de Ven & Johnson, 2006; Van de Ven, 2007), McCabe, Parker and Cox (2016) conducted a study between researchers and industry project leaders from 23 large-scale projects. Their results concluded that there is a ceiling to the co-production of knowledge, which arises from the preconceived beliefs of both researchers and industry that academic knowledge is of superior value. Both academics and industry partners interviewed held traditional views on university-industry collaborations. The scholars, however, concluded that the degree of engaged scholarship could be influenced by disciplinary variation and the nature and stage of the research problem.

To conclude: The engaged scholarship thesis does not focus on a shift in the balance between types of knowledge production, whether basic or applied, Mode 1 or Mode 2, with or without societal relevance, and with or without societal contributions. It focuses on closing the gap between theory and practice and is therefore suggestive by proposing that society (practitioners) should be part of the research process. Both knowledge producers and knowledge users can benefit from the process. The process does not pertain to only applied research, i.e., projects with immediate practical outcomes. It also applies to strategic research described by Irvin and Martin (1984) and Rip (2002), i.e., basic research relevant to society.

The final framework discussed in this literature study is academic engagement, which is the most recent framework of the ones addressed already. It is discussed in greater detail than the previous frameworks since it forms the foundation on which the empirical part of this study, concerning the oenology researchers, is built.

2.4 ACADEMIC ENGAGEMENT AND UNIVERSITY-INDUSTRY RELATIONSHIPS

2.4.1 DEFINING ACADEMIC ENGAGEMENT

Academic engagement is the "knowledge-related collaboration by academic researchers with non-academic organisations" (Perkmann et al., 2013, p. 424). Non-academic organisations can be multiple, and in the context of this dissertation, the focus is on industry organisations and practitioners. These researcher-industry collaborations can be formal or informal. The formal interactions include collaborative research, contract research and consulting and the informal activities include networking with practitioners and giving *ad hoc* advice. Academic engagement is therefore inter-organisational and usually includes face-to-face interactions.

Researchers pursue academic engagement for various reasons: to generate societal legitimacy for public-funded research, to access additional funding for research, equipment and student support, and to access learning opportunities for researchers who often lack practical knowledge of the real-life phenomena they are studying. Academic engagement in the form of collaborative research or contract research can provide academics with insights into ideas that can be commercially viable and, as a result, the opportunity to co-develop patentable inventions with industry.

In contrast to academic engagement's multiple advantages, commercialisation involving patenting and licensing is usually pursued primarily for financial gain (D'Este & Perkmann, 2011). However, universities' income from academic engagement is generally higher than from commercialisation (Perkmann et al., 2013).

Perkmann et al. (2013) point out that academic engagement is not a new form of knowledge production and transfer. Industry problems have traditionally been a powerful source of research ideas for both basic and applied science. Academic engagement has a long tradition in the US agricultural sector and the mission of land grant universities. However, the emergence of new research fields with novel technological opportunities, such as biotechnology and computer science in the 1980s stimulated renewed interest in university-industry interactions (Tartari, Perkmann & Salter, 2014). Recent policy and research interest in commercialisation have also led to a surge in publications on university-industry relations, making it seem like a new phenomenon.

Perkmann et al. (2013) are prescriptive when advising policymakers and industries interested in engaging with academia. They warned that information on the impact of academic engagement on research and teaching is scarce, and one cannot assume that engagement will always be beneficial for both parties involved. They also stress the importance of recognising that different knowledge and technology transfer mechanisms (engagement versus commercialisation) may require different support structures and incentive mechanisms. To industry, they advise that it is essential to recognise that collaborating with academia brings certain challenges. Academics will only work with industry if an academic benefit is derived. The latter aspect is because of the academic evaluation system that rewards the more traditional academic outputs such as publications and citations.

The following few sections elaborate on the academic engagement framework and university-industry relations in general to link the empirical study of oenology researchers in this dissertation to an existing body of knowledge.

2.4.2 FACTORS INFLUENCING ACADEMIC ENGAGEMENT

This section focuses mainly on factors influencing researchers' willingness to engage with industry in collaborative (joint) research, contract research, consultancy and other informal knowledge-related networking interactions.

Perkmann et al. (2013) divide the different factors that can influence researchers to engage in a knowledge-related collaboration with industry into three categories: individual characteristics of researchers, the organisational context and the institutional context. "Institutional" in this case refers to the field of research or discipline and the national policies and regulations of a country. "Institutional" in other scientific literature is sometimes used instead of "organisational", thus meaning something completely different. It complicates comparison between studies, and to avoid confusion, the term institutional will either be defined each time it is used or replaced with its subdivisions, i.e., research field and national factors.

2.4.2.1 Individual characteristics

Individual characteristics include gender, age, education, seniority, previous engagement experience, academic success, nationality and ability to attract funding for research. (Giuliani et al., 2010; Perkmann et al., 2013, 2021). Another set of individual factors includes researchers' intrinsic and extrinsic motivations to engage with industry (Franco & Haase, 2015; Iorio, Labory & Rentocchini, 2017; Perkmann et al., 2021).

The gender gap is nothing new in science, and several studies have reported it since the 1990s (Tartari & Salter, 2015). It reflects in teaching evaluations, scientific productivity, career trajectories, and recent studies also report on interaction with industry. However, most industry interaction studies have focused on commercialisation, and there is limited research on the type of industry interactions defined by Perkmann and co-workers as academic engagement. Empirical studies do not provide clear-cut results in terms of the effect of gender on academic engagement (Giuliani et al., 2010). Some studies report male researchers interact significantly more with industry than their female counterparts (Buttel & Goldberger, 2002; Boardman & Ponomariov, 2009; Tartari & Salter, 2015). Other studies find no significant gender differences (Gulbrandsen & Smeby, 2005; Van Rijnsoever, Hessels & Vandeberg, 2008). Tartari and Salter (2015) conducted an empirical study to determine the level of academic engagement of female researchers in physical sciences and engineering in the UK. They found that female researchers engage less with industry than their male counterparts. The authors point out that the specific disciplines they studied can play a role in their findings since physical sciences and engineering are male-dominated industries. Giuliani et al. (2010) conducted a study amongst researchers involved in viticulture and oenology research in Italy, Chile and South Africa. They found no significant difference between male and female researchers in terms of their level of industry engagement.

In terms of age, some studies report a positive correlation with industry engagement (older researchers engage more) and others a negative one (older researchers engage less) or no correlation at all (Perkmann et al., 2013). The negative correlation could be because older researchers underwent training when university-industry collaborations were less important. In contrast, older researchers with more senior positions are likely to have more extensive networks and thus potential research partners, explaining the positive correlation with age found by some studies. In the case of the Italian, Chilean and South African viticulture and oenology researchers, the younger researchers were found to have more links with their industries (Giuliani et al., 2010). Boardman and Ponomariov (2009) found a curvilinear (U-shaped) relationship between age and university-industry linkages, with younger and older researchers interacting more with industry than scientists in the middle of their academic careers.

Previous interaction with industry partners was found to positively affect a researcher’s attitude and enhance the chances of future interactions (Perkmann et al., 2013).

The academic success of a particular researcher is generally positively correlated with industry engagement (Perkmann et al., 2013). Senior academic personnel with a stable income and an established academic career are more likely to engage with industry than less established researchers who are still concerned with promotion and building a scientific reputation. However, some studies, as previously mentioned, also report younger, upcoming academics to be more likely to engage with industry because they view industry collaboration as professionally rewarding.

An individual researcher's ability to attract funding has been described as promoting the 'Matthew Effect' (Merton, 1968b) in academia. Traditional public grant funding is based on an academic peer review system. It is an indication of researchers' success in a particular field and their standing amongst international peers. A researcher's ability to attract public funding can signal the industry to invest in this 'successful' researcher for collaborative or contract research, promoting academic engagement. Industry funders are also more likely to approach the best-connected and most visible researchers (Callaert et al., 2015).

Researchers can also be intrinsically and extrinsically motivated to engage with industry (Iorio, Labory & Rentocchini, 2017). Intrinsic motivations include enjoying engaging with industry, feeling competent and getting a boost for their self-esteem when engaging with industry, and having a desire, or seeing it as their duty, to promote the university's third mission, i.e., knowledge transfer. Extrinsic motivations include obtaining funding for research, learning from practitioners, increasing their visibility to strengthen their reputations, and monetary incentives for consultancy and commercialisation.

The intrinsic desire to promote the university's third mission is also referred to as a pro-social motivation. Pro-social behaviour of researchers can lead to extrinsic rewards in the form of recognition and praise that positively influence their reputation and career prospects.

In addition to the motivations to engage with industry listed by Iorio et al. (2017), Franco and Haase (2015) add that researchers can also have future career-related motives or respond to national and organisational policies. South African examples of national and organisational policies that call for greater science communication efforts by researchers would be the Department of Science and Innovation's "*Science Engagement Framework*" and Stellenbosch University's "*Social Impact Strategic Plan*."

2.4.2.2 Organisational factors

Organisational factors that could potentially impact academic engagement include the academic quality of a specific department, the size of the department, the departmental peer effect and the university's performance evaluation system. There are no consistent patterns between the quality of a department (or university) and academic engagement due to the different 'quality' measures used by the studies that investigated a possible correlation (Perkmann et al., 2021).

The size of the department (as measured in terms of academic research personnel or research income) was found to have no significant effect on the level of university-industry collaborations (D'Este &

Patel, 2007; Giuliani et al., 2010). A growing body of research is looking at the peer effect on academics' propensity to engage with industry (Tartari, Perkmann & Salter, 2014). The studies show that there seems to be a degree of intradepartmental rivalry where researchers compare themselves with colleagues of similar academic status to advance their careers. This is especially the case if peers value traditional academic values. Tartari et al. (2014) found that some researchers may decide to engage with industry just to further their academic careers and not necessarily to promote universities' third mission of producing knowledge with social impact. This is similar to a finding from Lam (2007), who reports that tenured professors' primary motives for building links with industry are career-related.

Organisational promotional guidelines can affect academic engagement (Jacobson, Butterill & Goering, 2004a). If a university's evaluation system is based mainly on traditional academic outputs, such as publication in peer-reviewed journals, article citations and presentations at conferences and receipt of government grants, then industry engagement is not high on the priority scales of individual researchers and their academic units.

The specific recommendations for appointments and promotions of the Faculty of Agriculture, Stellenbosch University[3], which houses the Department of Viticulture and Oenology (the focus of the empirical study of this dissertation), place a strong emphasis on the academic output of researchers. The faculty's performance appraisal system for academic staff does reward interaction with relevant industries but only for its contribution to an academic footprint. Therefore, the faculty's evaluation system is heavily weighted towards academic outputs. It does not seem to include any incentive or reward for academic engagement that leads to anything other than publications and external funding. This could potentially negatively affect researchers' propensity to engage with industry and was investigated for oenology researchers in the empirical part of this dissertation.

2.4.2.3 Institutional factors

Factors grouped under institutional include specific research fields or disciplines, national regulations and public policies (Perkmann et al., 2013).

Disciplines differ in their cognitive knowledge structures (Becher, 1994). Some disciplines such as engineering, agriculture and biomedical sciences are more pragmatic in their knowledge and therefore

[3] Faculty of Agrisciences Stellenbosch University recommendations for appointments and promotions of academic staff document.

more inclined to result in products or techniques. On the other hand, natural sciences often involve a significant amount of basic and strategic research that results in discoveries or explanations rather than having applied outcomes. Academic engagement is, therefore, generally more likely in the case of the former fields.

Bentley et al. (2015) surveyed researchers from 15 countries to map their orientation towards basic and applied science. Engineering and agricultural researchers considered their work predominantly applied in contrast with the life sciences and physical sciences, where most researchers considered their work primarily basic. With natural science (that comprises life and physical sciences), the cognitive knowledge structure can be further from application than agricultural sciences.

National policies affect how funding is allocated to universities (Perkmann et al., 2013). In almost all OECD countries, national governments are still the main funders of university research (Bentley, Gulbrandsen & Kyvik, 2015). In addition, 'core' public funding is mainly allocated via input-oriented measures, e.g., in countries such as Germany, Netherlands, Norway and Finland. Output-oriented models are more dominant in Australia and the UK. For instance, the UK government favours researchers' proposals that can potentially generate social and economic benefits (Tartari & Salter, 2015). Research councils in the UK require a 'pathway to impact' to be submitted with grant proposals. In the case of two research proposals with equal academic merit, the funding will be awarded to the proposal with a higher potential social and economic impact. To demonstrate possible impact requires researchers to engage with industry (thus promoting academic engagement).

Most European researchers, however, still experience considerable freedom in terms of funding sources, research partners and research topics (Bentley, Gulbrandsen & Kyvik, 2015; Callaert et al., 2015). By implication, they are free to pursue curiosity-driven basic research (Auranen & Nieminen, 2010) that has less societal relevance and potential higher academic value in terms of journal impact factor and article citations. The pressure to turn to industry for funding, and thus engagement, is lower (Perkmann et al., 2013).

Within the South African context, the Department of Higher Education and Training (DHET) grants a subsidy for each scientific publication by a South African author or co-author listed in one of their three recognised journal lists (WOS[4], DHET and IBSS[5]) (Mouton & Valentine, 2017). They also provide output subsidies for students graduating and publications in conference proceedings. This output-

[4] Clarivate Web of Science

[5] International Bibliography of the Social Sciences

oriented subsidy is a substantial form of income for South African universities. As a result, subsidy-receiving universities put pressure on researchers to deliver in terms of academic outputs mainly. One can argue that in the case of South Africa, the national Higher Education policy greatly influences the organisational policies and the universities' performance evaluation systems.

2.4.3 BENEFITS OF UNIVERSITY-INDUSTRY RELATIONSHIPS

The addition of knowledge transfer, which includes technology transfer, as a third mission to the university's traditional teaching and research missions, has raised some concerns (Manjarrés-Henríquez, Gutiérrez-Gracia & Vega-Jurado, 2008). As a result, various studies have investigated the benefits, potential concerns, and drawbacks of university-industry relationships from many different perspectives. Most studies have focused on technology transfer (academic patenting and spin-off formations) when studying industry collaboration (Muscio, Ramaciotti & Rizzo, 2017). This is simply because it is easier to measure empirically than knowledge transfer through collaborative and contract research, which is practised far more widely (Cohen, Nelson & Walsh, 2002; D'Este & Patel, 2007; Banal-Estañol, Jofre-Bonet & Lawson, 2015). Since few studies focus on the benefits and drawbacks of academic engagement only, some of the studies mentioned in the following section refer to the broader category of university-industry relationships in general.

Ankrah and AL-Tabbaa (2015) classify the benefits associated with university-industry relationships in three categories: economical, institutional (organisational) and social. Even though their systematic review of the literature includes an extensive range of university and industry interactions, their classification system is nonetheless also relevant to the much narrower range of interactions seen as academic engagement, as described by Perkmann et al. (2021).

2.4.3.1 Economic-related benefits

Industry funding for collaborative and contract research generates an income for universities, departments and researchers. Some researchers rely on this industry funding to enhance their academic careers. Universities can also obtain additional funding through patenting, licencing and intellectual property rights. In addition, the latter creates business opportunities for universities.

Industry bodies such as firms benefit from university-industry collaborations when they commercialise university-based technologies for financial gain (Ankrah et al., 2013). Knowledge transfer between universities and firms can also enhance their sales, R&D productivity, and patenting activity.

Collaborative research projects are often more cost-effective to firms than in-house research, thereby lowering their overall costs. By providing firms access to facilities and expertise, universities help to advance knowledge and technologies with tangible economic outcomes.

2.4.3.2 Institutional (organisational) related benefits

Academic engagement exposes faculty and students to practical problems, new industrial technologies and new ideas and opportunities for research (Agrawal & Henderson, 2002; D'Este & Perkmann, 2011), which could also have positive effects on the teaching curriculum (Ankrah & AL-Tabbaa, 2015). The university can improve its infrastructure by obtaining state-of-the-art and up-to-date equipment. The latter can have a positive effect on the quality of academic publications, as well as student training. Student or researcher exposure to the industry can provide them with future employment possibilities (Bekkers & Bodas Freitas, 2008). Academic engagement generally builds trust and credibility for researchers amongst practitioners (Jacob et al., 2000).

Regarding the research agenda, the industry can serve as a sounding board by providing feedback on research ideas and helping to refine them (Ankrah et al., 2013). Industry can also help to stimulate research and technology development in certain key areas. Academic engagement can lead to increased and joint publications with the industry (D'Este & Patel, 2007). It also stimulates the development of spin-off companies (Acworth, 2008).

There are various advantages for industries or firms to collaborate with universities (Ankrah et al., 2013; Ankrah & AL-Tabbaa, 2015). Hiring highly qualified university students is viewed as a primary benefit to industries. Ongoing contact with university researchers provides continued professional development for industry employees. When products are tested at a university, it offers independent credibility to the results. Firms or industries can enhance their reputations by associating with prominent researchers or institutions.

2.4.3.3 Social benefits

Governments and the public are putting increased pressure on universities for entrepreneurship, greater social accountability, and overall relevance to society (Ankrah et al., 2013). This motivates university and industry actors to collaborate to contribute to economic development and social upliftment. Society thus benefits from the service delivered by universities. Universities fulfil their third mission, and in turn, it enhances the university's reputation. For example, universities in South

Africa have specific social impact strategies that, in many cases, address issues related to previously disadvantaged communities and individuals because of the country's political past.

2.4.4 CHALLENGES OF UNIVERSITY-INDUSTRY RELATIONSHIPS

Public and private funding relationships with universities are fundamentally different (Czarnitzki, Grimpe & Toole, 2015). Industries do not just replace decreasing public funding but impose additional requirements on academic researchers.

There are three main concerns related to university-industry collaborative and contract research: the effect on academics' research productivity, the "skewing" of research agendas at the expense of basic science, and restricted communication because of intellectual property rights.

2.4.4.1 Influences on research productivity

Literature on influences on research productivity is relatively scarce and inconclusive (Salimi, Bekkers & Frenken, 2015). The general concern is that researchers with industrial support will publish less (Perkmann et al., 2013).

Grant-based funding, whether from the government or industry, is awarded to either the ablest academics (Hottenrott & Lawson, 2017) or academics with the most relevant research proposals in terms of the requirements of the funding call. This external resource income, regardless of source, allows for an increase in research activity. As a result, academics that receive extra income to spend on research and infrastructure tend to have higher publication output than their colleagues who do not receive external grants (Hottenrott & Lawson, 2017). When the extra income from industry results in higher publication output, it is referred to as the 'resource effect' (Breschi, Lissoni & Montobbio, 2007). When researchers receive large private grants because they are tenured and receivers of large public grants (or the other way round), it is often referred to as the 'Mathew effect' (Merton, 1968b).

One of the earlier studies conducted amongst 1566 researchers from Quebec and across various disciplines concluded that collaboration with industry increased research productivity (Landry, Traore & Godin, 1996). This study included, in addition to industry collaboration, collaborations with other researchers within the same university and other institutions. The study found that collaboration's effect on academic output varied according to the specific field of research and the researchers' geographical closeness to their partners.

A study of 2052 life sciences faculty members of 50 US universities found that academics that received industry funding published more peer-reviewed articles in the previous three years than their colleagues who did not receive industry funding (Blumenthal et al., 1996). These academics also participated in more administrative activities in their disciplines and institutions and were more commercially active. However, the study also found that when more than two-thirds of academics' research funds came from industry, their academic output was less than those with lower industrial support.

Manjarrés-Henríquez et al. (2008) had similar results in their case study of two Spanish universities. They found a positive effect on academic output (number of publications) when university-industry collaboration was based on R&D contracts and when funding for these contracts did not exceed 15% of the researcher's total budget. Banal-Estañol et al. (2015) found an inverted U-shaped curve where collaboration with industry increases academic output, but when the degree of collaboration exceeds 30-40%, the academic output, or quality thereof, decreases. They ascribe this effect to the research ideas being of lower academic value, industry imposing non-disclosure clauses or extensive collaboration reducing actual time to do research.

Muscio et al. (2017) investigated how funding from industry contracts and consultancy in Italy related to academic output in terms of the volume of publication output and the number of citations. They focused their study on four scientific areas: natural sciences, engineering and technology, medical and health sciences and agriculture. They found the relationship between commercial funding, public funding and academic output very complex and heterogeneous across scientific fields. Natural sciences, as well as engineering and technology, displayed an inverted U-shaped relationship with industry funding, i.e., academic engagement has beneficial effects on research output up to a certain level of funding, which has negative consequences. This is similar to the findings of Manjarrés-Henríquez et al. (2008) and Banal-Estañol et al. (2015). In the case of the medical and health sciences, the impact of industry funding on academic output was detrimental if the funding was small. More significant amounts, however, increased scholarly output.

Guena (1997), in a study of 47 UK universities, found a negative effect of industry funding on publication output. Similar results were obtained by other scholars as well. Hottenrott and Thorwarth (2011) studied the impact of industry funding on the scientific output of 678 science and engineering professors at 46 universities in Germany. The researchers focused predominantly on their publication and patent output. They found that the higher the share of industry funding relative to a professor's total research budget, the lower the publication output of the professor. The industry funding did, however, have a very positive effect on patents registered and citations towards the patents.

Rentocchini et al. (2014) studied the relationship between the research performance and consulting activities of 2678 researchers from five different Spanish universities. Their results depended on the scientific fields and the intensity of the (academic) engagement. Academic consulting was negatively correlated with the number of publications in natural and exact sciences and engineering. This negative correlation between the intensity of consulting activity and publication output was not observed in the social sciences and humanities case. In terms of the negative correlation found in the case of the former, it was only observed when the level of consulting activity was high and not when it was moderate.

In contrast, other studies found that researchers who collaborated with industry publish as much, if not more, than researchers who do not collaborate (Van Looy et al., 2004; Gulbrandsen & Smeby, 2005; Abramo et al., 2009; Hottenrott & Lawson, 2017). Some of these studies found that even though publication output was higher for collaborative researchers, the average impact factor of the journals published in, was lower (Abramo et al., 2009; Hottenrott & Lawson, 2017).

The effect that industry collaboration can have on academic output seems variable. It could be positive, negative or curvilinear, depending on the field of research, the degrees of collaboration, the expectations of the funder and the nature of the empirical study, i.e., what is measured (publication quantity or quality). It is important to note that whilst one stakeholder, i.e., academia, might perceive the output of a specific research project as less valuable, the other stakeholder, i.e., the industry, can at the same time perceive the outcome as incredibly valuable to improve economic well-being and sustainability.

2.4.4.2 Influences on research agenda

The ‘skewing’ of the research agenda towards more applied research at the expense of basic research (Florida & Cohen, 1999) has been a concern ever since private funding first entered the academic arena. Researchers that are un-restricted in terms of their research agenda (as was traditionally and to some extent today still the case with some public funding) tend to choose research topics that will build their careers, reputations and those of their institutions. Usually, this involves curiosity-driven basic research aimed mainly toward an academic audience that can cite the research. Publication and citation counts are more important than industry collaboration and patents in evaluations for academic positions and university rankings (Berbegal-Mirabent & Sabate, 2015). As a result, there is this internal pressure on academics to publish as much as possible in the best journals possible, hence the concern that these evaluation objectives would not be met if they do applied research.

Industry funding usually requires applicability and therefore favours research agendas directed toward industry relevance. It was found that academics with industry support are more likely to report that their research topic choice is influenced by its commercial potential (Blumenthal et al., 1996). There is thus a concern that industry funding can skew the research agenda toward applied research to the detriment of basic research. Various types of studies addressed these skewing concerns.

The first type of study investigated the prevalence of basic research in university departments by surveying researchers to determine whether applied research was replacing basic research. Hicks and Hamilton (1999) found no decline in the percentage of basic research at US universities from 1981 (the Bayh-Dole Act was passed in 1980) to 1995. During this time, university patenting increased significantly. This increase can be ascribed to greater university commercialisation efforts and not necessarily a change in the research agenda (Thursby & Thursby, 2002).

Bozeman and Gaughan (2007) surveyed 1564 US scientists from various disciplines to investigate the impact of research grants and contracts on the nature of academic research, among various other objectives. They found that disciplines traditionally associated with basic research, such as physics, chemistry and mathematics, had much lower industry interaction rates than more applied disciplines such as agriculture, engineering and computer science. They concluded that, according to their study, there should be little concern that industry grants will negatively affect traditional basic research disciplines.

Ylijoki et al. (2011) did a study amongst Finnish researchers and found that basic research is viewed as vital in all disciplines studied and that there was no sign of such curiosity-driven research declining at Finish universities.

Bentley et al. (2015) surveyed 15 countries among researchers of various disciplines and found a strong presence of basic research in universities. However, they found large differences between disciplines and countries regarding the balance between basic and applied. In general, applied research was found to be more common.

The second type of study (bibliometric) looked at the possible trend toward applied publications at the expense of basic publications. Some scholars found no evidence of a trade-off between basic versus applied research publications (Van Looy et al., 2004; Van Looy, Callaert & Debackere, 2006). Van Looy et al. (2006) suggested that the co-existence of non-entrepreneurial and entrepreneurial research may reinforce each other.

Thirdly, financial data studies can provide insights into whether there is a substitution effect between externally funded applied research and publicly funded basic research.

In a study of financial data of life sciences departments, researchers found a substitution effect between externally funded applied research and publicly funded basic research (Quaglione, Muscio & Vallanti, 2015). Since they did not observe a positive relationship between industry-funded and publicly funded research, there was neither a “Matthew effect” nor a “resource effect” where increasing returns were generated because of access to external cognitive and financial resources. However, they did not find any substitution effect in traditionally basic research departments, similar to Bozeman and Gaughan’s finding (2007). They conclude that excessive emphasis on commercial activities can lead to the reduction of publicly funded basic research.

2.4.4.3 The ‘secrecy problem’

Contractual agreements related to intellectual property rights can delay or withhold results from publication (Blumenthal et al., 1996; Geuna & Nesta, 2006; Manjarrés-Henríquez, Gutiérrez-Gracia & Vega-Jurado, 2008; Hottenrott & Thorwarth, 2011; Banal-Estañol, Jofre-Bonet & Lawson, 2015; Czarnitzki, Grimpe & Toole, 2015). This can detract universities from their commitment to ‘open science,’ which relates to academic autonomy, the unbiased pursuit of truth and the broadest possible transfer of knowledge (Geuna & Muscio, 2009; Perkmann & Walsh, 2009; Ankrah et al., 2013). The latter allows for knowledge to be cumulative, accessible and reliable (Czarnitzki, Grimpe & Toole, 2015). It enables new knowledge to be replicated and verified by peers and avoids duplication of unnecessary research. Open science also allows for complementary research and an increase in the diversity of research by increasing the number of subsequent research lines.

There are various risks associated with publication delays, such as lower citations for the publication when it eventually appears (Salimi, Bekkers & Frenken, 2015), or worse, the knowledge can become obsolete (Ankrah et al., 2013). In terms of withholding results from publication, researchers can also potentially bias their results in favour of the sponsoring company, which poses a threat to the integrity of the academic study.

Various studies, however, report no negative effect of patenting on publishing (Agrawal & Henderson, 2002; Gulbrandsen & Smeby, 2005; Czarnitzki, Glänzel & Hussinger, 2007) and some studies report patenting to have a very positive effect on academic output (Perkmann et al., 2013; Berbegal-Mirabent & Sabate, 2015).

This concludes the first section of Chapter 2, which describes academic knowledge production. The narrative included many historical aspects of knowledge production building up to modern-day knowledge production involving non-academic stakeholders and the benefits and potential drawbacks associated with the latter.

2.5 KNOWLEDGE TRANSFER WITHIN ACADEMIA

The following section focuses on scientific publication (internal communication of researchers) specifically because of its extreme importance in the evaluation systems of individual researchers and universities.

2.5.1 THE PUBLISH OR PERISH CULTURE OF ACADEMIA

Publications are the most important output of academic research and a measurable indication of a researcher's productivity (Binswanger, 2015). It is a requisite for researchers' scientific reputations. The amount and quality of scientific publications of a university also significantly influence a university's reputation and rank and therefore result in pressures from universities on its research community.

Research papers are traditionally published in scholarly journals after a peer-review process. Peer review is often called the gatekeeper or holy grail of science as the system ensuring rigour, novelty and consistent quality of academic outputs (Spicer & Roulet, 2014; Parsi & Elster, 2018). The peer-review system, however, is highly diverse and can be flawed, but despite its potential shortcomings, it forms a core part of the self-regulating academic scholarship system (Tennant et al., 2017).

Journals serve as information dissemination platforms, allow authors to register their precedence and provide fixed archived versions of information for future reference (Johnson, Watkinson & Mabe, 2018). In 2018 it was estimated that there were approximately 33100 English scholarly peer-reviewed journals, plus about 9400 non-English journals, that published over three million articles annually (Johnson, Watkinson & Mabe, 2018). The growth in scientific articles can be ascribed to the increase in researcher numbers and the growth in research and development expenditure (Ware, 2011).

In the current academic system, researchers are mainly evaluated and rewarded according to their number of publications, the prestige of the journals they publish in, and the number of citations received by other researchers in scientific journals (Lawrence, 2003; Binswanger, 2015). As a result, researchers compete to try and publish as many articles as possible in journals with the highest prestige possible. There are currently more doctoral graduates in the world interested in academic positions than academic positions available, hence the fierce competition amongst individual researchers. This situation has often been described in the literature as the 'Publish or Perish' culture of academia.

In this culture, individual researchers, their departments and universities strive to improve their reputations and ratings by proving their academic excellence (Binswanger, 2015). The number of publications produced within a specific time frame is one of the ways to measure 'excellence'. Universities also promote collaboration with other scientists within a particular field. This can potentially lead to high citation counts. The strive for excellence leads to a reputational hierarchy in the social structure of scientific communities (Weingart & Taubert, 2016). This hierarchisation can steer the attention of researchers in a specific discipline towards relevant topics in that discipline that will increase their chances of being noticed and recognised formally (via citations) and informally in terms of their reputation amongst peers.

Further to the publish or perish culture, Binswanger (2015, p. 53) claims that universities have become "fundraising institutions" that aim to receive as much money as possible from funders. In addition, he claims that universities have become "publication factories trying to maximise their publication output" and whose "main concern is to make a measurable contribution to academic excellence". Edwards and Roy (2017, p. 53) claim that over-incentivising output (by allowing it to dominate decision-making in promotion and tenure, faculty hiring, funding and awards) can weed out altruistic actors and select researchers that are more comfortable and responsive to this "perverse incentive." It can also negatively alter academic behaviour by increasing unethical behaviour.

The pressure to publish, also described as 'hunting the article' (Dinis-Oliveria & Magalhães, 2015) or 'the lure of the luxury journal' (Lawrence, 2003), is a crucial consideration in this study since it directly influences the behaviour of researchers in terms of the type of research they are willing to conduct and the amount of time they are willing to devote to interaction with practitioners in knowledge transfer activities. The following sections will describe four facets of scientific publication: the peer review process, publication citations, the journal impact factor (JIF) and open access publication.

2.5.2 PEER REVIEW

Ross-Hellauer (2017, p.37) defines peer review as "the formal quality assurance mechanism whereby scholarly manuscripts (e.g., journal articles, books, grant applications and conference papers) are made subject to the scrutiny of others, whose feedback and judgements are then used to improve works and make final decisions regarding selection (for publication, grant allocation or speaking time)". "Others" or peers are usually academic researchers who are considered experts on the topic that needs reviewing (Kurdi, 2015). Peer reviewers are also referred to as referees. In the case of academic publishing, the comments by reviewers are usually respected by the editor, who is the ultimate decision-maker on whether an article will be published. The overall average of reviewers per article in all journals is estimated at 2.3 (Ware, 2011). The average time spent reviewing is estimated as five hours per article, although it will depend on the level of experience of the reviewer (Ware, 2011).

Journal prestige is the cumulative effect of various factors, of which the stringency and type of peer review are two (Binswanger, 2015). Other factors include the quality of the articles published, the academic standing of the editors and reviewers, the publication turn-around time, frequency of editions, the journal's rejection rate and the journal impact factor (JIF).

There exists a strict hierarchy between scholarly journals in every research field or discipline (Binswanger, 2015). The more prestigious the journals, the more stringent the peer review process and, as a result, a higher rejection rate of articles; hence the prestige if one's paper gets accepted (Spicer & Roulet, 2014). Journal rejection rates vary from 10% to over 90% (Ware, 2011).

The purpose of peer review is four-fold: to check for the soundness of the scientific methods employed and if the conclusions that were drawn can be considered valid; to give constructive comments to authors and help them improve the quality of their paper; to assess the novelty and significance of the article, and to assess the suitability of the article for publication in a specific journal in terms of its scope and readership (Ware, 2011; Kurdi, 2015; Ross-Hellauer, 2017; Johnson, Watkinson & Mabe, 2018). Researchers can benefit from the prestige of publishing in journals with strict peer review (Walker & Rocha da Silva, 2015) if it is recognised in their evaluation systems. Institutions benefit by using peer-reviewed publications as an indicator of academic excellence. Journals benefit by using peer review to select articles that will most likely attract many citations and thus improve the journal impact factor and prestige (resulting in increased journal revenue).

Researchers have various reasons to become journal reviewers (Mulligan, 2005; Ware, 2011). Some reasons are more 'academic' in nature, i.e., they review because they feel it is their academic duty, it is a way to stay up to date with the latest research, it stimulates new ideas for their research and to win the favour of the editor for when they want to publish in the journal. The other reasons are more 'personal achievement and reputation' in nature, i.e., younger researchers view it as an honour and acknowledgement of their standing in the research community, they review to be considered for the editorial board and to increase their reputation by being associated with a prestigious journal and thus help career development.

Peer review is not only a practice of academics but has also become an academic field of study due to criticisms of its efficacy and value (Ware, 2011). There is a steady growth in journal articles on peer review year on year, and the first International Peer review congress was held in 1989 (Ware, 2011). The main purpose of these articles and conferences is to reflect on the state of peer review, its benefits and critiques, and opportunities for improvements. Despite several identified shortcomings of peer review, academic authors and readers still find the screening function it offers crucial to scholarly communication.

This section provides a brief overview of the peer review process and drawbacks that can potentially influence researcher behaviour. For a comprehensive overview of peer review and the future of peer review, see Tennant et al. (2017).

2.5.2.1 The peer-review process

Walker and Rocha da Silva (2015, p. 5) classify the peer review process in seven “dimensions”: when the review takes place, what is assessed, who the reviewers are, the anonymity of authors, anonymity of reviewers – open review, reviewer author interaction and whether reader commentary is allowed.

- ***The timing of the review***

Until the early nineties, most articles published in academic journals underwent the classical peer review process or also referred to as pre-publication peer review. Many subscription journals still follow this route. Articles are submitted to journals where the editor or assistant editors do a quick ‘suitability’ check and then select two or three reviewers. These reviewers critically assess the articles for quality, novelty, the importance for the field and interest for the broad readership. Reviewers either suggest rejection of the article to the journal’s editor or provide a written report with suggestions for additional experimentation, argumentation or text revision (“Peer review is not broken”, 2018). Authors must comply with these improvement suggestions before the article is published, which is immediately after publication ‘the version of record.’

The early nineties saw the birth of pre-print servers/repositories where authors could bypass the restrictions, delays, bias and unreliability of classical peer review. The oldest and most well-established preprint server is ArXiv[6], created by Paul Ginsparg in 1991 and currently hosted by Cornell Computing

[6] http://arxiv.org/

and Information Science (Johnson, Watkinson & Mabe, 2018). This platform, where authors can publish papers before submitting them to journals and other research material not necessarily suitable for journal publication, comes from a strong tradition in mathematics and physics of distributing preprints in paper format amongst colleagues for comments before publication. In June 2020, ArXiv hosted 1 715 301 preprints in physics, mathematics, computer science, quantitative biology, quantitative finance, statistics, electrical engineering and systems science, and economics.

There are other preprint servers, but none is as successful as ArXiv (Walker & Rocha da Silva, 2015). Preprint servers are also discipline-specific, with physics, mathematics and astronomy more popular than biology and medicine, where the impact has been limited.

Articles published in preprint servers allow authors to solicit peers' comments before submitting them to academic journals. Preprint servers also serve as a channel for self-publication, especially in the case of ArXiv, where authors publish papers and research material they never submit anywhere else.

A pre-print server, although also categorised as a repository, should not be confused with other subject or institutional repositories, where published journal articles are deposited after an embargo period by authors or publishers into PubMed Central, for instance. Peer review has, therefore, already taken place according to the peer review method of the specific publishing journal.

Commercial peer review services such as Peerage of Science or Rubriq allow authors to submit their papers to commercial peer review services before submitting them to a journal (Walker & Rocha da Silva, 2015; Ross-Hellauer, 2017). The service can also submit papers on behalf of the author to journals after reviewing them.

Cascade review is also a form of pre-publication review. This is when the reviews done by the first journal where the article was submitted but rejected are passed on to another more ‘suitable’ journal by the same publisher, e.g., from specialised *PLoS* journals to *PLoS One*, with the authors’ permission (Ware, 2011). Articles can also be passed on to journals from different publishers (portable review), as in the Neuroscience Peer Review Consortium (Johnson, Watkinson & Mabe, 2018). The idea of cascade and portable review is to make reviews available to other journals to save authors the effort of resubmitting again and for the peer review process to start all over again. The benefit for authors is a faster route to publication.

Finally, the latest introduction to the pre-publication peer review process is the Manuscript Exchange Common Approach (MECA), an initiative co-led by John Sack, the founding director of HighWire (Johnson, Watkinson & Mabe, 2018). The idea is to develop a standardised approach to transferring manuscripts among and between online submission systems such as ScholarOne, eJournal Press and Editorial manager (Aries).

There are various types of post-publication (publish, then filter) peer review (Shirky, 2008; Tennant et al., 2017). One type is where a journal editor does a basic quality check and then publishes the article as a 'pre-print' or 'discussion paper' similar to pre-print servers such as arXiv and BioRxiv (Ware, 2011; Johnson, Watkinson & Mabe, 2018). The article is then open for review by appointed reviewers and the community. Comments can be anonymous or signed. This parallel review aims to resolve possible biases, elitism and closed networks associated with editor-assigned reviewers. By increasing the number of reviewers, the reliability of peer review can be increased (Bornmann et al., 2012). The article is formally published after one or more revisions, considering the reviewer and community comments (Ware, 2011). The article can also be rejected based on comments and reviews received. If published, several versions of an article can be available on the journal platform. Examples of journals using this form of peer review include *F1000Research* and various journals published by the open-access publisher Copernicus (Walker & Rocha da Silva, 2015).

In the specific case of *F1000Research*, the editor of a journal performs a quick sanity check to determine if the article fits the scope of the journal, checks for plagiarism and readability and then publishes the article on the journal website with the designation 'awaiting peer review' (Hunter, 2012; Ford, 2017). Reviewers are asked only to comment on the experimental layout and soundness of findings and not to comment on novelty and impact. Reviewer reports are published with the article along with their names and affiliations. Anyone from the research community can also comment on the article or the reports from the reviewers. Authors can resubmit articles as a response to reviewer reports. Once the article has been approved by at least two reviewers or approved with reservations by two reviewers and approved by one, the paper gets indexed by Scopus and PubMed.

F1000 Faculty Reviews, previously known as *F1000Prime Reports*, comprise post-publication recommendations by peers on already published articles from other journals, mainly in biology and medicine (Faculty of 1000 Ltd., n.d.). These reports are also now published in the journal *F1000Research*.

'Post-publication review' can also refer to reader comments after the article has officially been published and indexed. Well-known journals allowing this type of review are the *PLoS* series and Rapid Responses by the *British Medical Journal (BMJ)* (Tennant et al., 2017).

The advantage of post-publication peer review is that it can be a crucial self-correcting tool for science. It can possibly identify incorrect or fraudulent research results that slipped through the pre-publication peer review process (Peterson, 2018). Sites such as PubMed Commons, eLetters (Science), PubPeer, ResearchGate and F1000 can also provide criticism and feedback on published research, e.g., on the reproducibility of results.

- ***The focus of the review***

With selective review, reviewers are asked to consider the scientific quality of a specific paper as well as the novelty, importance, relevance and potential impact of the paper (Walker & Rocha da Silva, 2015). Most journals have traditionally used and still use selective review. This type of review originates from the pre-internet time when journals were only available in print, and publication space was therefore scarce due to economic reasons (Björk & Hedlund, 2015). Publication space was allocated to the articles most likely to interest the readers. Today this is still the case where journals publish a parallel paper version, but even journals that are electronic only can have reasons for restricting publication volume.

In non-selective reviews, reviewers are only instructed to assess scientific soundness. Whether the research presented in the paper is novel, meaningful, relevant, or impactful is left up to the readers to judge and vote with downloads and citations. This type of review has only been around since the first decade of this millennium because of the introduction of open access (OA) electronic-only journals (Björk & Hedlund, 2015). Open access journals that charge article processing charges (APCs) have good reasons to expand their publication volume since it increases revenue.

Open access publisher BioMedCentral was the first publisher to introduce this non-selective review. However, it became popular because of the phenomenal growth of the mega-journal *PLoS One* since its introduction in 2006 (Björk, 2015). Within five years of its launch, *PLoS One* became the most prominent peer-reviewed journal in the world (MacCallum, 2011). As a result of the success of *PLoS One*, many established publishers have since launched their mega-journals using this type of technical soundness only review (Björk, 2015). Examples include *Scientific Reports* (Springer Nature), *BMJ Open* (BMJ Publishing Group), *SAGE Open* (SAGE) and *FEBS Open Bio* (Elsevier). Not all mega-journals use this type of review, with *ELife* being an example of an exception in that it is highly selective in reviewing article impact. Another exception is predatory journals that are open access journals, with sometimes rather large volumes of articles that could quantify them as mega journals, except that not even review for technical soundness takes place (Beall, 2013; Bohannon, 2013).

Mega-journal non-selective review holds various advantages for authors (Björk, 2015; Björk & Hedlund, 2015). It addresses the elements of bias towards specific authors, countries and topics for which traditional peer review has been criticised. As a result, it leads to lower rejection rates and shorter lead times to publication as authors do not have to go through various cycles of submission, rejection and resubmission. It, therefore, speeds up the publication process and the availability of new results (Walker & Rocha da Silva, 2015).

According to Buriak (2015), the growth of mega-journals can be limited in the long run due to the availability of motivated reviewers. Björk (2015) argues that reviewing for mega-journals provides less social capital-building opportunity than reviewing for classical peer-reviewed journals. Researchers reviewing for traditional journals can eventually be appointed to editorial boards or become associate editors, a factor that can be less prominent with mega-journals.

Björk (2015) also argues that authors' willingness to publish in mega-journals is another limiting growth aspect, as some institutional evaluation systems place more value on articles published in journals with stricter acceptance criteria and publishing only in mega-journals might not be viewed as favourable.

The non-selective review has also been met with some resistance and called "peer review lite[7]" or an academic dumping ground for articles rejected in more specialised journals (Pinfield, 2016; Spezi et al., 2017).

As mentioned in the previous section, there are journals with questionable or no peer review despite their claims (Beall, 2012; Shen & Björk, 2015; Mouton & Valentine, 2017; Johnson, Watkinson & Mabe, 2018). Publishers of these journals base their revenue model on the Gold Open Access model, where authors pay to have their papers published. Because they have only very superficial or no peer review, they can accept large numbers of papers and publish after very short lead times. Their revenue, therefore, comes from high-volume publishing. These predatory publishers claim to be from developed first-world countries such as the United States of America (USA) and the United Kingdom (UK) but are, in fact, predominantly from India, Nigeria, or Pakistan (Beall, 2012). Several studies have also revealed that authors who publish in predatory journals are mainly Indian and African (Ezinwa Nwagwu & Ojemeni, 2015; Shen & Björk, 2015; Xia et al., 2015). Authors publish in predatory journals either as victims not knowing these journals are conning them (Mouton & Valentine, 2017) or knowingly and hoping the parties involved in evaluating their research output do not realise that the article output list contains predatory journal published articles (Shen & Björk, 2015). In the case of the

[7] https://www.timeshighereducation.com/blog/mega-journals-future-stepping-stone-it-or-leap-abyss

former, the government or funding body that listed predatory journals as acceptable journals to publish in is to blame for authors falling victim to these scams.

Some universities or governments of developing countries place a strong emphasis on publication in international journals to prove academic excellence but then do not monitor the quality of the journals the academics publish in. This opens the possibilities for researchers to knowingly publish in predatory journals. These universities and governments can also be partly responsible for the rise in the predatory publishing enterprise.

One of the first persons to expose this predatory publishing enterprise was Jeffrey Beal, a librarian at the University of Colorado in Denver, USA. He created a list called Beal's list, which contained journal titles of what he believed to be predatory. Beal's list was shut down on 31 December 2016 and was moved to a new site in 2017, where it is being maintained by an anonymous person (Chen, 2019). Not long after the shutdown, another list, Cabell's Blacklist, became available (Chen, 2019).

Publishing in predatory journals undermines confidence in the peer review system and the general public's trust in science and its products (Mouton & Valentine, 2017). The legitimate publishing industry has responded in various ways to combat predatory publishing (Johnson, Watkinson & Mabe, 2018). They have strengthened their codes of conduct and created resources such as Think Check Submit[8] to allow researchers to check publication best practices. The Directory of Open Access Journals also strengthened its criteria for inclusion in its list. It removed all journals not meeting these criteria and those of the Open Access Scholarly Publishers' Association (OASPA).

- ***The reviewers***

Reviewers can be the journal editors themselves or be selected by the editors, automated databases, or proposed by authors, and reviewers can be the broader academic community (readers) (Björk & Hedlund, 2015; Walker & Rocha da Silva, 2015). Before the middle of the 20th century, it was not uncommon for editors of journals to review articles themselves and make decisions on whether an article should be published (Parsi & Elster, 2018). Today this process is highly unusual, especially for journals that handle high submission volumes (Walker & Rocha da Silva, 2015).

The standard way of choosing reviewers is for editors or assistant editors to assign reviewers based on their knowledge of the field and the researchers operating in them (Björk & Hedlund, 2015). Editors

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[8] https://thinkchecksubmit.org/

can also assign reviewers after checking the submitted manuscript's references. High-volume journals are nowadays supported by a database of researchers that have indicated their willingness to review. Editors can then pick from this editorial board based on the similarities of the authors' specialities and the potential reviewers on the board.

Taking the use of an editorial board one step further, the assignment of reviewers can be fully automated, where the reference lists of submitted manuscripts are matched algorithmically with the publication lists of the editorial board. Researchers on the editorial board who have co-authored with the submitting researcher in the past are excluded to avoid bias. An example of a publisher using such a system is the open-access publisher Hindawi in its ISRN series of journals. Since the request for review is not personally from the editor, several invitations usually need to be sent out to get enough reviewers who accept. However, since the editorial board consists of researchers willing to review, enough reviews are usually obtained this way.

Some journals allow authors to suggest reviewers and/or people they do not want to review (Walker & Rocha da Silva, 2015). In some cases, the suggested reviewers must be on the journal's editorial board, if it has one. Editors consider the authors' wishes, but the final appointment of reviewers remains at the editor's discretion.

In the case of community review, readers of a journal using such a review system can comment on an article when it is first published as a pre-print version. These comments will also be considered, along with those of the anonymous appointed reviewers, before the 'version of record' is published. The journal *Nature* experimented with such a review system from June to September 2006 but did not continue since most of the comments received were not significantly useful to the editors ("Peer review on trial", 2006). Very few authors were willing to allow community review, and very few readers commented, either because they didn't have the time or were not interested in commenting. This is despite the significant traffic the trial received.

However, as previously mentioned in the section 'Post-publication review,' various journals publish pre-print versions of articles and employ open peer review where editor-selected reviewers and the community can comment on the submitted manuscript.

- ***Anonymity of authors and reviewers***

There are three types of peer review methods in terms of anonymity of authors and reviewers: double-blind review, single-blind review and open review. Today single-blind review is the most common approach in many scholarly publishing areas (Tennant et al., 2017; Johnson, Watkinson & Mabe, 2018). This is where authors are known to reviewers, but reviewers are not known to authors. Proponents of single-blind reviews suggest that knowing the identity of authors can help identify possible conflicts of interest (Walker & Rocha da Silva, 2015). It can also help compare the paper to the author's previous research. However, single-blind review can also lead to the ‘Matthew Effect’ (Merton, 1968b), where famous or more established researchers’ works are favoured for publication or a competitor’s work is more negatively reviewed. Single-blind review is most used for medicine and natural science (Walker & Rocha da Silva, 2015).

Double-blind review is when the reviewers are unknown to the authors and vice versa (Mulligan, 2005; Kurdi, 2015). The advantage of a double-blind review is that it minimises bias towards lesser-known researchers, less prestigious institutions and female authors. Double-blind review is more common in the social sciences, arts and humanities (Walker & Rocha da Silva, 2015).

- ***Open review***

Open peer review is an umbrella concept for various peer review innovations (Ross-Hellauer, 2017). This is when the authors’ and reviewers’ identities are known to each other (Ford, 2017; Walker & Rocha da Silva, 2015). The intention behind open peer review is to promote transparency, collaboration and sharing of knowledge, fairness and accountability by reviewers (Ware, 2011; Ford, 2017).

Open review can refer to various types of openness (Ware, 2011; Ross-Hellauer, 2017). It can mean that the reviewers’ identities are known to the authors but not made public (the *BMJ*). Or the reviewers’ names are known to the authors and made public by being published with the paper (*F1000 Research*). Reviewers can also be anonymous during the review process, but after completion, their names are published with the paper, as is the case with *Frontiers* journals. Authors can also select reviewers in the case of some journals, in which case they are also known to the authors.

Openness can also refer to access to the reviewer reports, where the reviews of accepted manuscripts are published alongside the articles. Certain journals publish reviewer reports but keep their identities anonymous, as with *The EMBO Journal*.

The final form of openness is when journals allow comments by the wider academic community (and the public if the journal is open access).

There are advantages and disadvantages of open review. Open review minimises problems associated with blind reviews, such as long timespan between submission and publication and abuse of authors by reviewers. It also addresses the misnomer of 'blindness' as it is possible in some cases for reviewers to recognise a peer's work through self-citations, research topics or writing style (Mulligan, 2005; Dinis-Oliveria & Magalhães, 2015).

A study conducted between similar journals with different review systems found that open review improved the quality of reviewer reports by 5% (Kowalczuk et al., 2015). However, when the study was repeated within a journal that offers both types of peer review, there was no difference in the quality of reviewer reports. Another study found no significant differences in the quality of reviewer reports, whether they were signed or not (Van Rooyen et al., 1999). However, the reviewers took a little longer to complete their reports (about 25 minutes), and the acceptance rate to review was lower.

Open peer review can also have the opposite effect of what was intended by promoting less open and honest reports than what one would obtain when reviewers are anonymous. According to Mulligan (2005), younger reviewers might also be cautious with their comments on manuscripts of more established researchers for fear of damaging their own careers or funding possibilities. It was also found that reviewers might be less likely to review if they know their identities will be made known to authors (Van Rooyen et al., 1999).

Open review enables increased accountability and transparency of the process and provides an incentive to peer reviewers by acknowledging their contribution to scholarly publishing as reviewers, i.e., reputational credit (Ross-Hellauer, 2017).

- ***Interaction between authors, reviewers and editors***

In classical peer review, there is no interaction between reviewers or authors and reviewers (Walker & Rocha da Silva, 2015). Examples of journals that allow interaction are *EMBO Journal* and *eLife*, which allow interaction between reviewers before the editor decides to ensure a more balanced review process.

The review process can also occur in the open, with exchanges between reviewers, authors and the editor published in real-time. *Frontiers* journals have a Collaborative Review Forum that enables direct interactions between authors, reviewers and editors. The article is published after the author has had a chance to revise it.

- ***Reader commentary***

Reader commentary, allowed by some journals, is an informal post-publication review process after the version of record has been published (Walker & Rocha da Silva, 2015; Ross-Hellauer, 2017). It is not to be confused with open post-publication review on pre-print articles where reader commentary is part of the evaluation process, together with formal reviewers, in determining whether a paper will officially get published and indexed. There are two types of reader commentary: 'in channel' where the journal allows comments, and 'out of channel' where readers comment on social networking sites such as ResearchGate, Mendeley, Academia.edu or platforms such as Pubpeer.com and PubMed Commons. Reader comments on academic research can also happen on Twitter and on blogs. 'Out of channel' reader commentary is usually only for papers attracting extraordinary attention from the public. Academic research papers generally do not attract many comments, with the most attracting none (Walker & Rocha da Silva, 2015). There can be various reasons for this, such as fear of being wrong, fear of upsetting more senior researchers, or the fear of giving away good ideas.

2.5.2.2 Drawbacks of peer review

With classical peer review, there can be significant delays between submission and publication, which in turn delays the dissemination of novel research (Armstrong, 1997; Bornmann & Daniel, 2010; Brembs, 2015; Walker & Rocha da Silva, 2015; Jubb, 2016). However, open peer review can combat these delays by publishing preprint versions of the articles in the journal (Ware, 2011; Johnson, Watkinson & Mabe, 2018).

Peer reviewers often fail to detect mistakes and fraud ("Can peer review police fraud?" 2006). Because reviewers do not replicate experiments, it is possible that errors or fabricated results can be overlooked. It can also be that reviewers do not sufficiently scrutinise a study, and mistakes or fraud can go unnoticed ("Peer review is not broken", 2018). Numerous high-profile papers were later retracted when errors or misconduct were detected. Scientists are supposed to seek the truth on society's behalf, but they are human and can fail. The enormous pressure scientists are under to publish or perish often leads them to misconduct. There are also cases where it is tough to replicate results and where absolutely no wrongdoing took place, and then there is also just bad science that can go unnoticed.

There can be bias against certain result types. Many important scientific discoveries were turned down initially by journals just because they seemed too good to be true (Mulligan, 2005). This holds for many Noble class discoveries (Campanario, 2009). Some journals also prefer positive results to negative ones

(Mahoney, 1977; Emerson et al., 2010). Major journals are reluctant to publish replication studies. If novelty is preferred to replication (not just by journals but also by institutional evaluation systems), false results or bad science and even fraudulent science remain in the literature unchallenged (Moore et al., 2017). According to Smaldino and McElreath (2016), this can lead to the natural selection of bad science. These papers will continue to be cited, and research built upon their false results will invariably be a waste of time and resources and can be damaging to the reputation of science (Peterson, 2018).

Classical peer review is also criticised for protecting the status quo – suppressing research that seems too radical or in contrast with the reviewers' research (Mahoney, 1977; Horrobin, 1990; Benda & Engels, 2011; Alvesson & Sandberg, 2014; Siler, Lee & Bero, 2015; Siler & Strang, 2016).

Studies have shown very poor agreement between reviewers, with levels of agreement little more than chance (Mahoney, 1977; Smith, 2006; Kravitz et al., 2010; Herron, 2012).

Peer review can include social bias, such as bias against female authors (Budden et al., 2008), lesser-known authors, authors from lesser-known institutes (Dall'Aglio, 2006) and language (Cronin, 2009)although the social bias is declining. Social bias is also relevant in incidences where prestigious authors' articles are reviewed more favourably because of their reputation more than the quality of the article (Mulligan, 2005).

Some reviewers can be guilty of unethical practices, especially in the case of blind reviews (Smith, 2006). Such practices by reviewers include delaying acceptance by requesting further work or outright rejection, publishing first (Mulligan, 2005) or blatantly plagiarising the author's ideas (Ware, 2011).

Reviewers can also be too thorough by "nit-picking" at every argument or piece of data and requesting endless additional experimentation ("Peer review is not broken", 2018).

Where there is no recognition for reviewers, it can also be considered a drawback (Armstrong, 1997; Walker & Rocha da Silva, 2015). Open review, however, where reviewer identities and reports are published with the paper, to some extent, enables credit for reviewers (Ross-Hellauer, 2017). Publons, owned by Clarivate, is a platform that addresses the 'no recognition for reviewers' drawback' by collecting verified information from reviewers and publishers and turning it into a measurable research output that researchers can put on their CVs (Van Noorden, 2014).

Despite all the drawbacks, peer review remains the most critical system to control the soundness of the knowledge produced. It must not be seen as a system whose primary function is to detect fraud. Instead, it aspires to improve the quality of academic research published and, where possible, assure the correctness of published results (Mulligan, 2005).

2.5.3 PUBLICATION AND CITATION-BASED METRICS

Publication and citation-based metrics used in university evaluation systems include the number of publications researchers produce in a specific time frame, the prestige (of which the journal impact factor is viewed as an indication) of the journals they publish in, and the number of citations received by other researchers in scientific journals (Lawrence, 2003; Binswanger, 2015). As a result, researchers aim to publish as many articles as possible in journals with high impact factors where they hope to attract the most citations. It is not easy to publish in journals with high impact factors, and it could potentially affect the type of research an academic is willing to conduct to pass the strict peer review process of high impact journals. In turn, it can affect researchers' willingness and availability to engage with industry audiences. These aspects were explored in this dissertation's empirical study and are therefore discussed in the following sections to provide background for the results obtained.

2.5.3.1 Origin and meaning of the journal impact factor

The purpose of citations to other researchers' published papers is to help authors build their arguments by referring to earlier and related work (Johnson, Watkinson & Mabe, 2018). It also serves as a way for researchers to navigate scientific literature. The number of citations an article receives is often used to measure its impact and quality. Using citations as an indicator for quality has also been extended to indicate journal quality by means of the Journal Impact Factor (JIF).

Eugene Garfield first conceptualised an impact factor for science in 1955 (Garfield, 2006). The first Science Citation Index (SCI) was published in 1964, and the first annual SCI Journal Citation Report (JCR) was issued in 1975 (Garfield, 2007). Garfield's company (later owned by Thomson Reuters and nowadays Clarivate) issuing the reports were known as the Institute for Scientific Information (ISI) (Pendlebury, 2009).

"A journal's impact factor is based on two elements: the numerator, which is the number of citations in the current year to items published in the previous two years, and the denominator, which is the number of substantive articles (source items) published during the same two years." (Garfield, 2007, p. 19). The original purpose of the JIF was to serve as a bibliometric tool to assist librarians in their choice of journals to subscribe to (Moustafa, 2015; Savage, 2018).

Since 2016 Clarivate (formerly Thompson Reuters's Intellectual Property & Science business) has owned the Web of Science (formerly Web of Knowledge) that issues the annual JCRs, containing the latest journal impact factors (Teixeira da Silva, 2017).

The JIF has been described as "the single most influential metric in science publishing for the past forty years" (Teixeira da Silva, 2017, p. 433). The influence, however, has been highly controversial, with the same author also describing it as "the single greatest corrupting factor in science, because of its abuse by scientists and their institutes for often placing unwarranted value on a citation count, thereby erroneously equating the JIF with quality, validity, and scholarship" (Teixeira da Silva, 2017, p. 433).

Journal impact factors were not designed to measure the quality of an individual paper or researcher. Yet researchers are regularly ranked according to the impact factors of the journals where their publications appeared (Alberts, 2013). In some countries, whether institutions will get government funding depends on their number of publications in high-impact journals ("The Impact Factor Game. It is time to find a better way to assess scientific literature", 2006). In China, researchers can get paid up to $165 000 by the government when they publish in *Nature* or *Science*. Various other countries offer cash bonuses to researchers for publications, and in some cases, like in China, the amount depends on the JIF (Abritis & McCook, 2017).

In the case of open access journals, the article processing charges (APCs) are often proportional to the JIF (Al-Khatib & Da Silva, 2017). So, a new "pay to publish or perish" culture has been created where those with money have the advantage.

2.5.3.2 Criticisms of the journal impact factor

The JIF is calculated using the total number of citations to the total number of articles and reviews published in two years in a particular journal. However, 20% of articles generally receive 80% of the citations (Pendlebury, 2009). This is even the case for high impact journals where, for instance, 89% of the 2004 *Nature* impact factor was generated by 25% of the articles published in 2002 and 2003 ("Not-so-deep impact", 2005). Clarivate has, for the first time in 2018, as a response to concerned editors and publishers, introduced a new journal profile page that shows the full citation distribution for the calculation of the JIF (Johnson, Watkinson & Mabe, 2018). It also includes institutional and geographical contributions.

Some subject fields attract more citations than others, especially areas of great interest with many research grants, researchers and journals (Spier, 2009). More specialised fields or new fields attract fewer citations because fewer researchers cite one's work. It does not mean the quality of the research done in the new field is any less than that of the research in the well-established field. Citations are therefore much more of an indication of an article or journal's popularity than its quality.

The two-year citation window is too short for some research fields that typically only peak in terms of impact after three to five years (Martin, 2016).

Some JIFs can be inflated in the numerator (Pendlebury, 2009). The numerator also contains citations to editorials and letters that are not counted in the denominator. So naturally, journals with a high incidence of such content can have higher impact factors than journals in the same field with mostly only original research reports.

Other ways the JIF numerator is inflated are through self-citations, negative citations, honorary citations and reciprocal citations, to name a few (Moustafa, 2016). Authors cite their previous publications to refer to previous work related to the current publication. They can also cite their work to inflate their h-indexes (Bartneck & Kokkelmans, 2011). Some studies report (depending on the field) that 10 – 20% of all citations are self-citations and can substantially affect citation-based metrics (Hyland, 2003).

Studies can be cited for being considered wrong or having weaknesses in their experimental layout (Spier, 2009). Such citations are deemed negative and therefore not an indication of good quality.

Honorary citations are when people cite their colleagues or supervisors (Moustafa, 2015). Reciprocal citations are when people cite other authors who previously cited them, i.e., returning the favour.

Many authors cite review articles instead of the source where findings were reported for the first time (Moustafa, 2015). As a result, journals that publish many reviews tend to get more citations than journals in the same field reporting only primary research findings. Some editors restrict review articles to “by invitation only,” where only well-known authors with long-standing careers are invited to write for the journal to attract more citations. Review articles by junior researchers are only considered if endorsed by at least one well-established author.

One of the “impact factor mania” consequences is the disincentive to pursue risky research that can potentially lead to ground-breaking results (Alberts, 2013, p. 787). Such research might take years to achieve worthwhile results that are publishable in high impact journals. Instead, researchers prefer to work on hot topics that give them a better chance to publish in high impact factor journals (Moustafa, 2015).

Researchers can also waste their time chasing high impact factor journals by entering endless submission/rejection cycles instead of focusing on their research. Dissemination of knowledge to the broader community is also hindered as a result.

2.5.3.3 The journal impact factor and unethical behaviour

The darker side of impact factor mania is when it leads to unethical behaviour (Moustafa, 2015). High-impact journals are more prone to publishing falsified research that is, if discovered, later retracted. Misconduct occurring during the production process, such as falsification, fabrication and plagiarism, is usually referred to as traditional misconduct. Retractions are often also because of peer review tampering and not necessarily because of the science itself reported in the paper (Biagioli, 2016). Such misconduct has been described as postproduction misconduct, as it targets the publication system and not the science. The 'publish or perish' culture has become 'impact or perish.' Famous retraction incidents because of peer review tampering include the 2015 BioMed Central (BMC) retraction of 41 Chinese papers, followed by Springer retracting 64 and Elsevier and *Nature* retracting nine and three, respectively (Han & Li, 2018). There have also been various reports of authors supplying fake e-mail addresses in the case of journals that allow authors to suggest peer reviewers for their submitted articles (Biagioli, 2016). Such reviews are usually overly positive.

The misconduct does not stop with authors. Editors of journals are also under tremendous pressure from their publishers to maintain or improve their JIFs. Such stress can lead to coercive citation, where editors request authors to add citations to their journal in their article or risk rejection (Wilhite & Fong, 2012; Martin, 2016). Additional citations increase the numerator in calculating the JIF for the journal. It is thus a way to inflate the JIF in an unethical manner. Coercion is 'uncomfortably common', with lower-ranking scholars more likely to give in to intimidation than researchers with established careers (and less pressure to publish). With their published article, these scholars are rewarded for being co-conspirators in the self-citation game.

Another stratagem used by editors to inflate the numerator that may be viewed as less dubious is to use editorials to cite large numbers of articles recently published in the journal (Martin, 2016). Citation stacking and citation cartels are, however, downright misconduct in that journals boost each other to inflate their JIFs.

In light of all the shortcomings of the JIF and all the editorial practices to inflate the JIF, it is pretty surprising that such a measure can still carry so much weight in academia.

In 2013 the San Francisco Declaration on Research Assessment (DORA) was released as the outcome of a 2012 meeting of concerned researchers ("DORA – San Francisco Declaration on Research Assessment (DORA)", n.d.). The main aim of DORA is to stop the use of the JIF to evaluate individual scientists. The declaration, signed by various researchers, journal editors and funders, makes several recommendations. The critical request is not to use journal-based metrics such as the JIF to make hiring, promotion, or funding decisions but to consider a broad range of impact measures, including influence on policy and practice. The latter aspect of influence on practice is specifically relevant to the current study.

Citations are essential in disseminating scientific knowledge (Moustafa, 2016). However, the improper use of citation-based metrics by academic evaluation systems and funders of academic research is very harmful to scientists and science and recommendations such as those by DORA “are critical for keeping science healthy” (Alberts, 2013, p. 787).

This concludes the discussion on the journal impact factor. In terms of engagement with non-academic stakeholders, institutional and organisational factors can affect the propensity of researchers to do so (Perkmann et al., 2021). One of the most profound ways they affect researchers is through their metrics-based evaluation systems for funding, promotion, and tenure, hence the discussion of the different facets of scientific publication in the sections above. A type of academic publishing, namely open access publishing, is a form of scientific communication that can be viewed as a potential boundary-spanning activity (externalising science) between the academic community and intermediaries and practitioners and is therefore also included in this discussion of scientific publication. Open access publication was explored as a knowledge transfer channel in the empirical phases of this study.

2.5.4 OPEN ACCESS PUBLISHING

In the past (pre-1990s), scientists primarily published in subscription journals not accessible by practitioners. Today they have a choice of publishing open access or making their subscription-based journal articles open access immediately or after an embargo period. Open access (OA) refers to literature that is digital, online, free of charge for the end-user, as well as free of most licensing and copyright restrictions (Suber, 2012). There exist, however, various degrees of openness. Free to read to the end-user does not necessarily mean the literature is also without usage restrictions or that it is free of copyright, or that it became open in a legal manner. The first official definition and description of OA appear in the Budapest Open Access Initiative (BOAI) declaration (Chan et al., 2002). This declaration underpins the modern drive to make academic publications more accessible to other researchers and the public.

For academia, the main drivers behind this OA movement are the ‘serials crisis’ and the access or impact problem (Harnad, S., Brody, T., Vallières, F., Carr, L., Hitchcock, S., Gingras, Y., Oppenheim, C. & Hajjem, 2004). Most academic journals are controlled by a monopoly of publishers that control the pricing of these subscription journals (Sotudeh, Ghasempour & Yaghtin, 2015). These publishers sell their subscriptions via 'big deal' contracts to institutional libraries (Basson, 2019). These big deals contain collections of journals predetermined by the publishers and not necessarily the libraries' needs. Libraries have very little bargaining power regarding which journals they want to be included in the deals. In some countries, consortia or bodies representing universities negotiate deals with publishers that better suit their needs (Butler, 2016). However, big deal negotiations are protected by non-disclosure agreements, making it difficult to determine the actual costs of these deals (Suber, 2012).

Because of the publish or perish culture, academics strive to publish in the most prestigious journals (Lawrence, 2003) and not necessarily the most affordable ones. Publishers are driven by high-profit margins and investor satisfaction (Volkmann, Schimank & Rost, 2014). Prestigious journals or deals containing these journals are expensive and often beyond the financial means of many university libraries, creating an access problem, and researchers can only cite articles they have access to. Libraries can also lose access to earlier issues of journals when they unsubscribe to digital copies of less popular journals (Cullen & Chawner, 2011) to save costs to be able to afford the more prestigious journal publisher deals.

Open access journals bypass the serials crisis as libraries do not have to subscribe to these journals for researchers to have access (Basson, 2019). It is a viable business model for new and less popular journals. Open access publication also provides a broader readership potential (Suber, 2012) for authors that could lead to a higher 'impact.' The impact authors are most concerned with are citations, but for funders of the published research, the impact also translates to usage by the public, primarily practitioners of the subject field. The latter addresses another issue that drives the move to OA. That is the public's right to access information generated by public taxes (Guédon, 2008; Harnad, 2015). The verdict is still out on whether there is a citation advantage for researchers publishing in OA journals (Basson, 2019).

According to Johnson *et al.* (2018), OA can be considered in terms of what is made open, when it is made available and where it is made open. In each case, there are three main options. In the case of journal articles, 'what' can refer to the author's originally submitted paper, the accepted manuscript after peer-review and copy editing, or the version of record. In the case of 'when', OA can be granted immediately after a sanity check and before formal publication, immediately on publication (version of record) or after an embargo period. 'Where' refers to the publisher's site (immediate or delayed), OA repositories from institutions, subject fields or funders, academic social media sites or personal author websites.

There are two main types of OA articles commonly referred to as gold and green open access. Depending on the business models, platinum/diamond and bronze open access also exist within the gold and green categories. Instead of charging libraries and institutions a subscription fee, the journals use supply-side payments for publication. These charges are referred to as article publication charges or article processing charges (APCs). There are many different author-based payment options. They include the authors, research funders, and institutions paying per article or pre-payments for a defined number of APCs. There are also options for institutional memberships, which entitle researchers to publish for free or at a reduced rate.

Gold OA journals make articles available for everyone immediately upon publication, for example, the *PLoS* Journals. Articles can even be published before official publication with open peer review, as in the case of *F1000Research*. Gold OA journals charge APCs from authors, or they are funded by sponsorships from learned societies, research performing organisations, research funders, libraries, foundations, government agencies, etc. These Gold no-APC journals are sometimes referred to as Platinum or Diamond OA.

Green OA is a form of delayed OA and refers to researchers depositing published journal articles in a repository after an embargo period. This means the paper is hosted in an OA format on a different platform than the publisher's site. Embargo periods can range from six to 18 months, but some are longer. This practice is also referred to as self-archiving. Repositories can, e.g., be institutional, subject-specific or funder websites. Many funders have clear mandates on OA and the embargo periods they will allow. Some publishers deposit articles on behalf of authors in funder repositories.

Many subscription journals have OA options for their sites. One such option is hybrid OA. With hybrid OA, publishers gain income from subscriptions and APCs from the same customer (Pinfield, Salter & Bath, 2016). This concept is known as 'double dipping' and is a significant cause of concern for libraries and funders. The APCs for hybrid journals are usually more expensive than full OA journals. Because authors are driven to publish in 'prestigious' (mostly subscription-based) journals, they opt for hybrid OA (if funders mandate Gold OA) because it allows them to still publish in their journal of choice. Many funders or institutions offer block grants for APCs, and the most significant percentage of the money pays for hybrid APCs, increasing the profit margins of the monopoly of publishers even more.

Subscription journals can also offer delayed or transient OA (Johnson, Watkinson & Mabe, 2018). Journal-delayed OA refers to journals making their articles OA after a specific time. Transient OA relates to articles made OA only for a particular time. Rogue OA, also referred to as black OA by Björk (2017), relates to articles made available for free in breach of publisher or journal copyright, for instance, via the website Sci-Hub. In June 2020, the Sci-hub website hosted 82 325 776 scientific papers obtained illegally from publishers' websites. This is not considered OA publishing as defined by the BOAI.

Funders widely support the drive to publish open access. There is especially support for immediate open access. A well-known example is the Bill and Melinda Gates Foundation that mandates both research outputs and the supporting data generated from their funding must be published as immediate open access. Other funders give authors the option of gold or green open access but stipulate the permitted embargo period. In South Africa, the National Research Foundation (NRF) requires that all researchers that receive funding from the NRF should deposit their publications in the Foundation's institutional repository within 12 months (Basson, 2019). Due to the rising costs of open access publishing worldwide, there are indications that the support for hybrid open access will be phased out.

Regarding the uptake of OA publishing, research shows that scientists are very aware of it and believe it is valuable (Ruiz-Perez, 2017). Even though scientists have a positive attitude towards OA, it does not necessarily translate into practice, indicating some barriers to the uptake of open access.

According to Ross-Hellauer, Schmidt and Kramer (2018), the main barriers to OA publishing are the following:

- Lack of funding for APCs for gold OA publication
- The perception that OA journals are of lower quality
- Lack of awareness of green OA options
- The complexity of licensing and embargo policies
- Lack of incentives (promotion, tenure) to publish OA within research institutions
- General uneasiness with new workflows

It is the general conclusion that the uptake of OA has been slower than hoped for despite mandates and that the market is no longer accelerating (Björk, 2017; Johnston, 2017; Ross-Hellauer, Schmidt & Kramer, 2018).

2.6 CHAPTER SUMMARY

This chapter aimed to describe the world of the global academic community to provide a background to the empirical study of South African oenology researchers who are part of this world. The first part of the chapter described scientific knowledge production at universities and how it formed external relations to adapt to public accountability and funding needs. Academic engagement was highlighted, as it provided a broad framework to phase 1 of the empirical study. The second part of the chapter focused on publications in scientific journals because of their importance in academic evaluation systems for promotion and tenure as well as funding. The take-home message from this chapter is that various factors influence scientific researchers' day-to-day activities, and expectations are bestowed upon them by their employers, the universities and their funders, whether public or private. Researchers must comply with these expectations to maintain and improve their academic standings within the global scientific community. This leaves researchers in a position where they constantly try and balance excellence (the expectation of the academic world) and relevance (the expectation from industries and society).

The next chapter provides insights into the world of practitioners, specifically South African winemakers explored in the empirical study.

CHAPTER 3: THE SOUTH AFRICAN WINE INDUSTRY AND THE KNOWLEDGE UPTAKE OF WINE INDUSTRY PRACTITIONERS

3.1 INTRODUCTION

This chapter discusses the actors / role-players involved in knowledge production, knowledge transfer and knowledge uptake and utilisation in the South African (SA) wine industry (Figure 3.1). The discussion evolves predominantly around two communities: The wine scientists in the Department of Viticulture and Oenology (DVO), Stellenbosch University (SU), and winemaking practitioners (winemakers), as opposed to the broader industry comprising many other actors in the grape-growing and winemaking value chain.

The first part of this chapter outlines the specific landscape wherein these two communities co-exist and interact. However, since the knowledge transfer and uptake system in the SA wine industry cannot be seen in isolation, the chapter's second part discusses factors influencing knowledge uptake by practitioners in general. In addition, previous studies involving wine industry practitioners from different parts of the world are discussed to provide a background to the current empirical study of winemakers and intermediaries.

3.2 THE SOUTH AFRICAN WINE INDUSTRY

3.2.1 OVERVIEW OF THE SOUTH AFRICAN WINE INDUSTRY

The SA wine industry's founding date is 2 February 1659, when Jan van Riebeeck, the Dutch governor of the Cape Colony, made the first wine from grapes grown on South African soil (South African Wine Industry Directory, 2021). It was, however, only when the Cape Colony was under British rule that wine became the main export commodity of the Colony (Boshoff, 2012). Various events and the country's political situation (Apartheid) would shape the industry into what it is today, more than 360 years later.

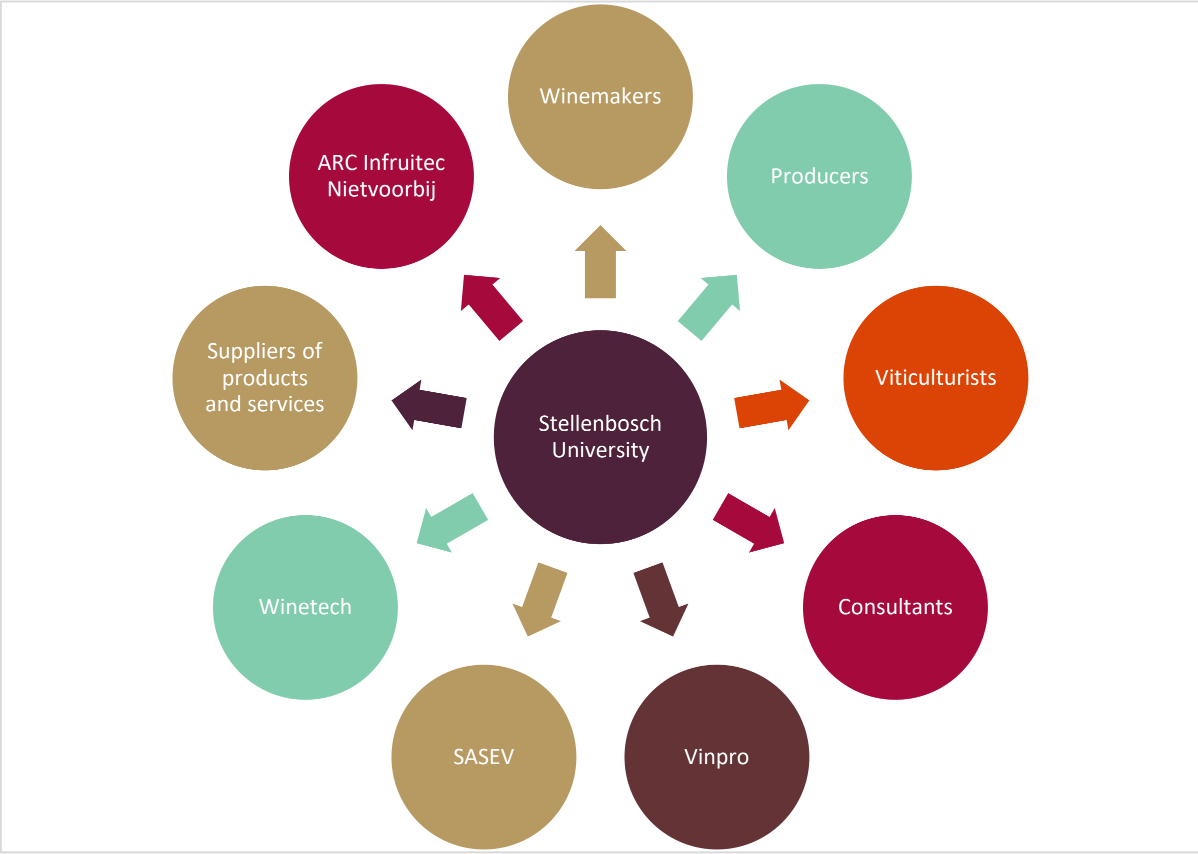

Figure 3.1: A schematic diagram demonstrating the main actors in the South African wine industry's technical grape growing and winemaking knowledge exchange. Stellenbosch University is the foundation of scientific knowledge for the South African wine industry, mainly because of its undergraduate and postgraduate courses in viticulture and oenology-related fields.

A significant event relevant to this study was the establishment of the KWV (Ko-operatiewe Wijmakersvereeniging van Zuid-Afrika) as a company in 1918 and later as a co-operative in 1923. The KWV had statutory powers to regulate the SA wine industry for 73 years until deregulation in the early 1990s (Esterhuyse, 2019). The deregulation entailed the KWV becoming a private company with no statutory powers. As part of this process, it was obliged to provide 200 million South African Rand (ZAR) to the SA Wine Industry Trust (SAWIT) over ten years. SAWIT, through two committees, provided funding to various industry bodies and initiatives. This was the start of the statutory funding system in the SA wine industry today, albeit not via the KWV anymore. Currently, all wine grape producers and producing cellars pay statutory levies, which include a research levy. This levy is the primary source of income for Winetech (Wine Industry Network of Expertise and Technology NPC), the wine industry body responsible for funding academic research in oenology and viticulture-related fields. For a detailed historical overview of the SA wine industry, see Boshoff (2012) and Esterhuyse (2019).

In 2021 the SA wine industry had 90 512 hectares (ha) of area under vines (wine grape varieties)(*SA Wine Industry 2021 Statistics Nr 46*, 2021). There were 2613 primary wine grape producers and 536 producing wine cellars. South Africa ranked eighth in the world regarding the volume of wine produced and contributed to 4.1% of the world's wine production. South Africa exported 42.6% of its production. Table 3.1 captures the key statistics of the SA wine industry.

Table 3.1: The South African wine industry statistics 2021

Area under vines (wine grape cultivars)	90 512 ha
Primary wine grape producers	2613
Producing cellars	536
Tons harvested	1 389 978
Litres harvested	1133.3m
Litres of wine sold in the domestic market	392.9 m
Litres exported	387.9 m
% Of SA wine exported	42.6%
Ranking in the world (volume of wine produced)	8
SA's contribution to the world's wine production	4.1%
SA's litres per capita wine consumption	6.53
Primary wine producers' income (billion ZAR)	R6.65
State income from VAT and excise on wine industry products (billion ZAR)	R7.26

Source: SAWIS (*SA Wine Industry 2021 Statistics Nr 46*, 2021)

3.2.2 STRUCTURE OF THE SA WINE INDUSTRY

Two organisations steer the SA wine industry: Vinpro and Salba (South African Liquor Brand Owners Association) (South African Wine Industry Directory, 2021). Vinpro represents approximately 2500 wine grape producers, wine producers, estate wineries, producer cellars and associated members. Vinpro focuses on member-specific services such as its consultancy business, knowledge transfer, training and development. Vinpro also liaises with the SA government regarding regulatory issues concerning the wine industry.

Salba is a non-profit organisation representing large manufacturers and wholesale distributors of liquor products, including brandy, wine and RTDs (Ready to Drink).

In addition to these two leading organisations, four regulated business units service the industry in field-specific focus areas. They are Winetech, SAWIS (South African Wine Industry Information and Systems), WoSA (Wines of South Africa) and SAWITU (South African Wine Industry Transformation Unit).

Winetech acts as an intermediary between the SA wine industry and research institutions. It funds academic research, people development and innovation. It also performs an essential knowledge transfer function in the industry. A more detailed description of Winetech's role in the SA wine industry will follow in the next section, as it plays an integral role in the two study components of this dissertation.

SAWIS manages the legal certification of wines through the Wine of Origin Scheme. It also collects, processes and disseminates industry statistics and information. Winetech and SAWIS are funded by statutory levies on all wine grapes harvested and wines produced.

WoSA promotes the sales of SA wines in international markets via research, communication and marketing endeavours. WoSA is funded by a statutory levy that is proportional to the volume of the member's exports.

The fourth receiver of statutory levies is the SAWITU, which is dedicated to transforming the SA wine industry. Overseen by a committee, the SAWITU supports black-owned enterprises, black farmers, and entrepreneurs in the wine value chain.

The National Agricultural Marketing Council (NAMC) governs the wine industry's statutory levies. It is a special council within the South African government's Department of Agriculture, Land Reform and Rural Development (NAMC, 2021). The NAMC promotes market access for SA agriculture via four strategic objectives:

- to increase market access for all market participants,
- to promote the efficiency of the marketing of agricultural products,
- to optimise export earnings from agricultural products; and
- to enhance the viability of the agricultural sector.

Vinpro, Salba and the NAMC are all represented on the four wine industry business units' board of directors.

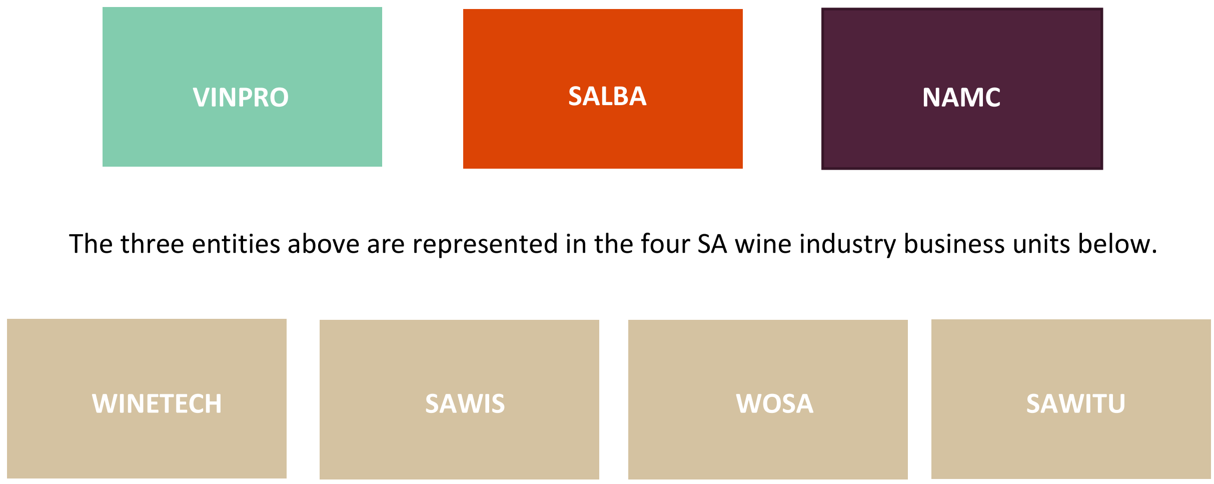

Figure 3.2: Organisational design of the South African Wine Industry
Source: South African Wine Industry Directory (2021).

3.2.3 WINETECH

3.2.3.1 Historical overview

The origin of Winetech dates to the mid-1990s, a period typically associated with the end of Apartheid, the end of sanctions against the export of SA products, including wine, the deregulation of the KWV and the re-establishment of Stellenbosch University's Department of Viticulture and Oenology (DVO).

At the end of Apartheid, with export markets opening, there was a demand for quality wines from South Africa (Esterhuyse, 2019). Unfortunately, the country was focused on quantity over quality for a very long time due to the KWV system that was in place. A need for increased quality wine production thus arose along with the need for knowledge on how to produce quality wines. At the time, there was only one professor in Oenology at Stellenbosch University, who was retired but was reappointed because of the shortage of expertise. The knowledge void Stellenbosch University (SU) and the SA wine industry were facing was solved with SU establishing the Institute for Wine Biotechnology (IWBT) within the DVO in 1995 and offering an upcoming young professor in Microbiology, who specialised in wine yeast research, the position of Director of the IWBT. Professor Pretorius agreed to help SU and the SA wine industry to establish proper undergraduate and postgraduate degrees in oenology and viticulture. Winetech, a non-profit organisation, was founded by the SA wine industry in 1996, with funding from the deregulation of the KWV. Its primary purpose was to assist Prof. Pretorius and his research team with establishing a proper postgraduate research institute that can perform world-class wine-related research. The endeavour was very successful, and today the DVO has undergraduate and postgraduate programmes on par with international standards. The current structure of the DVO is discussed in section 3.3.3.

3.2.3.2 Winetech structure

Winetech is a non-profit company registered as the 'Wine Industry Network of Expertise and Technology NPC' (Winetech Annual Report, 2020). Winetech's current vision is *"to help create a wine industry that recognises and uses science and technology as foundation stones for its success"* (Winetech, 2021). Its mission is: *"to identify, prioritise, commission, complete and transfer research, development and innovation projects/initiatives that will directly contribute to strengthening the profitability and competitiveness of the industry in the local and international markets."*

According to the Winetech Annual Report (2020), Winetech has eight board members and one observer. The following stakeholders are represented on the board: Vinpro NPC, Salba, Western Cape Department of Agriculture, National African Farmer's Union (NAFU) and the Research Institute for Innovation and Sustainability (RIIS). The NAMC is represented as an observer. Winetech's personnel consists of seven permanent employees and one technical advisor. All financial and human resources are contracted out to SAWIS.

Winetech has four focus areas, of which the first three are the most relevant to this empirical study:

- Research and Development
- Innovation
- Knowledge Transfer
- People Development

3.2.3.3 Research, Development and Innovation

Winetech funds research that will contribute to the SA wine industry's profitability, international competitiveness, and sustainability (Winetech Strategy, 2017). Its strategic focus is to achieve and maintain a research distribution of 20% fundamental research, 60% applied research and 20% innovation research. As discussed in chapter 2, it is not always possible to categorise a research project in only one of these categories since projects can contain elements of two or all three categories. Winetech prioritises projects that ultimately deliver practical and economic benefits to the industry.

Winetech operates via a committee system where expert committees comprising SA wine industry stakeholders evaluate new project applications, project progress reports and final reports (Winetech

Research, 2020). These committees meet annually, usually in March, June, and September. During the March meetings, concept proposals are discussed and if successful, applicants can submit a full project proposal for the June meetings. Full project proposals must contain a clear outcome and significance for the South African wine industry in addition to the foreseen academic output. Applicants must indicate with whom they consulted to determine the projects' relevance and importance to the industry. Progress and final reports are discussed at the September meetings. Final funding decisions for the next year are made after these meetings.

In 2021 Winetech funded 48 projects that comprised mainly academic research related to viticulture and oenology and, to a lesser extent, knowledge transfer and training (*Winetech Annual Report*, 2021). There were ten specialist committees with 73 members. Except for the Technology Transfer committee, all the other committees' projects were academic research. Only two of the projects on the Technology Transfer committee were academic research. The rest comprised knowledge transfer projects.

In terms of oenology research, Winetech, through industry consultation, has identified three priority areas for research: Winemaking process improvement, wine quality improvement and method development (A. Oelofse, personal communication, 3 February 2021). Currently, the balance is more towards the funding of viticulture-related research projects when compared with oenology-related projects.

Whereas Winetech only funded research projects that could lead to knowledge transfer in the past, it now allocates 20% of its funding to projects that can potentially translate to technology transfer. Developed projects and processes protected by intellectual property rights can potentially contribute to the sustainability of Winetech. Winetech's sustainability is threatened due to various challenges facing the SA wine industry: water scarcity, energy uncertainty, ageing vineyards, the COVID-19 pandemic and the accompanying government alcohol prohibitions.

3.2.3.4 Knowledge transfer

Knowledge transfer forms part of Winetech's four core functions, and Winetech uses various platforms for this purpose (Winetech Knowledge Transfer Strategy, 2020). As Winetech has a lean infrastructure (only seven permanent employees), its in-house focus is creating awareness of new factual knowledge in a unidirectional knowledge transfer approach. These knowledge transfer platforms include the publication of semi-scientific popular articles in the Winetech Technical part of *WineLand* magazine, a monthly industry magazine published by WineLand Media. These articles are mainly written by Winetech-funded researchers, industry consultants and Winetech personnel. The articles are published as received and are not necessarily relevant to the time they are published.

The second unidirectional knowledge transfer platform Winetech uses is email newsletters. Once a month, Winetech employees scan international viticulture and oenology academic journals and the research database Scopus for the latest viticulture and oenology research. Articles relevant and useful to the SA wine industry are summarised in a two-minute read and published on the Winetech website. An email newsletter containing links to the summaries is sent to a database of mainly winemakers, viticulturists, producers, suppliers of oenological products and services, and researchers. The email also occasionally contains links to the latest technical articles on the *WineLand* magazine website (the same as in the printed magazine), the latest blogs by SA consultants and even to international website articles and blogs. The email programme provides statistics on the number of emails successfully delivered, opened and links clicked.

The third form of unidirectional knowledge transfer Winetech utilises is the publication of books and booklets. Books are written by current or retired researchers who are experts in their fields. The booklets (30 – 40 A4 pages) are usually created to support the cultivar groups' yearly technical seminars. It is a compilation of information obtained from various stakeholders and includes the latest research (compiled by Winetech) related to the grape variety the associations promote.

Winetech also supports scientific communication amongst the research community by providing sponsorships to the South African Society for Enology and Viticulture (SASEV) conference and the *South African Journal of Enology and Viticulture (SAJEV)*.

Winetech uses third parties through funding and contractual agreements in interactive knowledge transfer channels. One such third party, already mentioned, is Vinpro. Winetech provides funding to Vinpro to host regional information days where viticultural knowledge is exchanged between researchers, consultants, suppliers, viticulturists and wine grape producers. The knowledge comprises new research results, factual knowledge, and practical knowledge. Winetech also provides funding to Vinpro for knowledge transfer events related to vineyard demonstration sites (Gen Z project) and managing and attending producer and viticulturists study groups. All these initiatives provide Winetech, via Vinpro, with potential industry research or knowledge transfer needs.

Oenology-related interactive knowledge transfer happens mainly via cultivar group associations such as the Pinotage Association, the Chenin Blanc Association, Sauvignon Blanc South Africa, Shiraz South Africa, and the Merlot Forum. Winetech makes a financial contribution to these groups' technical seminars and provides booklets with technical information related to the grape varieties. These seminars are well-attended by winemakers.

3.2.4 THE SOUTH AFRICAN SOCIETY FOR ENOLOGY AND VITICULTURE

Founded in 1977, the South African Society for Enology and Viticulture (SASEV) is a learned society comprising academic and non-academic members associated with the SA wine and table grape industries (SASEV, 2021). It serves as a forum for presenting the latest scientific information related to grapes and wine to the various industries. In terms of its offering to the SA wine industry, the focus is mainly academic, i.e., scientific conferences and a scientific journal.

The South African Journal of Enology and Viticulture (SAJEV) was first published in 1980 in hard copy format (SAJEV, 2021). It has since moved online and is hosted by Stellenbosch University's SUNJournals on its Open Journals Systems platform. SAJEV is an open-access journal. Its 2020 Journal impact factor determined by Clarivate Web of Science Journal Citation Reports is 1.833. It is published bi-annually and contains scientific papers, review papers and research notes of both South African and international research.

3.2.5 SUPPLIERS OF PRODUCTS AND SERVICES

Suppliers have a commercial interest in dealing with practitioners in an industry, so their interaction with the industry can be very regular. Wine production requires products and services, and winemakers depend on suppliers. Suppliers communicate the features of new products and the technical knowledge that accompanies the products (Hill & Hathaway, 2015). They also offer after-sales support.

The 2021 South African Wine Industry Directory (SAWID) lists 74 products and services suppliers for the SA wine industry (South African Wine Industry Directory, 2021). This is not an exhaustive list since suppliers must pay for a listing in this directory, and some choose not to. It does, nonetheless, give an estimate of the size of this category in the SA wine industry.

The technologies and accompanying knowledge offered by suppliers can have strong research and development foundations generated by academic and private institutions. Suppliers provide an instrumental knowledge transfer channel in the SA wine industry. Because of their position between theoretical and practical knowledge and winemakers' needs, they can be classified as intermediaries. The degree to which suppliers are exposed to learning and the perceived quality of the knowledge they transfer can determine their effectiveness as intermediaries (Dippenaar, 2017). Suppliers use various platforms to communicate and interact with the industry, such as phone calls, email newsletters, social media, technical seminars and most importantly, very regular face-to-face visits.

3.2.6 WINEMAKERS

There are 536 cellars crushing grapes and producing wine in South Africa (SA Wine Industry 2021 Statistics Nr 46, 2021, p. 3). These cellars can be divided into various categories. They are defined as follows:

- A **producer cellar** is a role player/entity where grapes are received and processed on behalf of a group of wine grape producers and its members into wine grape products and the marketing thereof as packaged or bulk.
- A **private wine cellar** is a role player/entity belonging to an individual or group where grapes are received and processed into wine grape products and the marketing thereof as packaged or bulk.
- A **producing wholesaler** is a role player/entity that buys wine in bulk and packaged format from wineries and/or other retailers but also buys grapes for own production. (Such an entity does not necessarily have its own premises.)
- A **wine producer** is a role player/entity that processes grapes, whether his own or purchased (i.e., does not own his own farm), on his own premises. If a role player processes grapes on another role player's premises, separate registration is not required. This is in line with SARS legislation.
- A **wine estate** is the same as a wine producer, with the difference that his own farm must be demarcated as an estate. The cellar and the farm must form a unit. Demarcation is done by the Wine and Spirits Board.

Cellars employ winemakers to make wines from the grapes received from grape growers (farmers). Winemaking requires a degree of scientific knowledge, and as a result, most SA winemakers have formal qualifications from academic institutions such as Stellenbosch University or Elsenburg Agricultural Training Institute (Boshoff, 2012). There are different categories of winemakers, depending on their level of expertise and seniority within a cellar environment. The following main categories exist in the SA wine industry: assistant winemaker, winemaker and cellar master (the most senior) (South African Wine Industry Directory, 2019). In addition, there are variations of the title winemaker, such as head winemaker, white winemaker, red winemaker, and sparkling winemaker. Cellarmasters can also be referred to as production managers. Some winemakers also fulfil dual roles in the cellar, such as owner/winemaker and manager/winemaker. Winemakers regularly move to new cellars, work as 'flying winemakers' abroad or diversify to new positions such as general manager or CEO of cellars. Assistant winemakers can also have seasonal contracts. Some winemakers can work at one cellar and be appointed as a consulting winemaker at another. Some wine brand owners who use a consultant to make their wine for them or who make wine on a very small scale, which is therefore not their full-time occupation, can also be indicated as a winemaker on certain databases.

Consequently, it makes it difficult to maintain an up-to-date, concise database of all full-time winemakers in the SA wine industry. However, there are 533 wine-producing cellars in SA. One can assume that they will all have at least one winemaker. The bigger the cellar operation, the more winemakers and assistant winemakers are employed. In 2019 the Winetech database contained 534 winemakers who gave consent to receive email communication from Winetech. Even though not exhaustive, the database includes the names and contact details of the wine industry's most important and influential winemakers. It also consists of the contact details of the winemakers from the biggest volume wine cellars in the industry.

The primary role of the winemaker is in the cellar and entails managing the winemaking process, i.e., the conversion of picked grapes into grape juice and wine. It also includes the stabilisation of this wine and eventual packaging of it into a sellable product. Winemakers work closely with grape producers and viticulturists to determine the optimal harvesting time to achieve the desired wine style. However, over the past two decades, the winemaker’s role has expanded to include wine sales and marketing. Today more senior winemakers spend a substantial amount of their time in sales and marketing activities. Previous studies in this thesis have not factored in or explored this additional role and its influence on the frequency and how winemakers interact with knowledge sources. It is investigated in this empirical study.

3.3 STELLENBOSCH UNIVERSITY

Stellenbosch University (SU) commenced its first operations on 2 April 1918 with 503 students, 40 lecturing staff and four faculties: Science, Education, Arts and Social Sciences, and AgriSciences (Stellenbosch University Timeline, 2021). Today it has more than 30 000 students, 3 000 staff members and ten faculties. Stellenbosch University is ranked in the 251-300 category by the Times Higher Education World University rankings and placed third in South Africa by QS Rankings (Stellenbosch University Research Stats and Figures, 2020). It has more than 280 bilateral partners in 63 countries on six continents. The key entity relevant to this study is the SU department: Viticulture and Oenology, which is discussed in section 3.3.3.

3.3.1 UNIVERSITY INCOME STREAMS

Stellenbosch University has various income streams (*Stellenbosch University Annual Integrated Report*, 2019). Two of these income streams are relevant to this study. They are the first stream (government subsidies for teaching and learning and research) and the third stream (research grants and contracts).

3.3.1.1 First stream income

The first income stream, i.e., government funding, is the most significant income stream of the university. It comprises 38.7% of the income generated in 2019. It is mainly the Research Output subsidy that interests this study. The national government (Department of Higher Education and Training – DHET) grants a subsidy, according to the Research Outputs Policy (South African Government Research Output Policy, 2015), for scholarly publishing in accredited scientific journals, books and published conference proceedings. The policy does not differentiate between the different outputs, for instance, whether a journal has a high or low impact factor or whether it is a South African or international journal. Only that it must be included on the DHET list for journals qualifying for a subsidy. Institutions claim the outputs of the preceding year in the current reporting year. The subsidy is paid out according to institutional affiliation. If the SA authors reside at the same institution, that institution gets the entire subsidy. The subsidy is shared between institutions where the authors are affiliated with more than one higher education institution.

Therefore, the more South African researchers publish in qualifying journals, the more money their affiliated institutions generate via the government. In 2020 the DHET amount paid per publication subsidy unit to SU amounted to R 128 436 (D. Pieterse, personal communication, 3 February 2021).

The DHET also pays an input (upon registration) and an output (upon graduation) subsidy for each student at a South African university. Differentiating amounts are paid for different degrees, with PhD degrees being awarded the highest subsidy.

3.3.1.2. Third stream income

Stellenbosch University's third income stream comprises research grants and contracts (*Stellenbosch University Annual Integrated Report*, 2019). These grants and contracts can either be public or private funding. The ratio of public versus private will differ for each Department/Institute/Centre within SU. Stellenbosch University's third stream income, although less than its first stream income, plays a vital role within the university environment since it enables the first stream income. Third stream income can also be from South African and international sources. Winetech is one of SU's third-stream income sources.

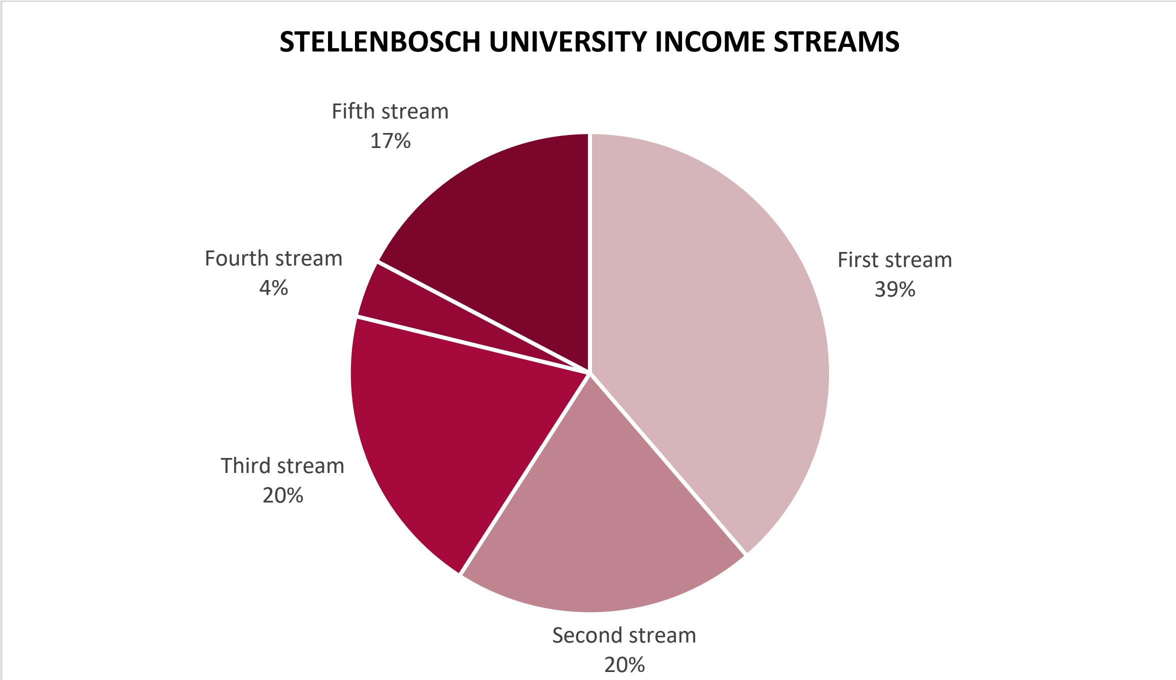

Figure 3.3: Income streams (rounded figures) for Stellenbosch University during 2019. First stream (government subsidy for teaching and learning and research); second stream (student fees for academic programmes, accommodation, and services); third stream (research grants and contracts); fourth stream (philanthropic donations); and fifth stream (investment income, commercialisation, technology transfer, short courses) (*Stellenbosch University Annual Integrated Report*, 2019).

3.3.2 THE FACULTY OF AGRISCIENCES

The faculty of AgriSciences was one of the founding faculties of SU (Faculty of AgriSciences Academic Programmes and Faculty Information, 2021). Today the faculty consists of 11 departments and two institutes. The faculty also has two experimental farms that are utilised for both undergraduate teaching and post-graduate projects. This faculty is relevant to this study as it houses the DVO and The South African Grape and Wine Research Institute (SAGWRI). The faculty's mission is to be the "preferred provider of world-class research, education and service to agriculture and forestry in Southern Africa" (p. 4). Its research "forms a seamless continuum, from pioneering fundamental investigations, through market-driven applied research, to relevant technology development and transfer aimed at practical implementation" (p. 4).

To this end, the faculty's recommendations for appointments and promotions of academic staff recognise interaction with relevant industries if such interaction results in an academic footprint[9]. The recommendations also reward the ability to attract external research funding (third stream). It does, however, have a primary focus on scholarly records and outputs.

3.3.3 DEPARTMENT OF VITICULTURE AND OENOLOGY

3.3.3.1 Structure

The DVO was established in 1927 and is one of the oldest departments within SU[10]. It is a traditional university department that offers under- and postgraduate teaching and research in the core sciences of Viticulture and Oenology. The DVO is the only university department in South Africa that provides these programmes. Currently, most young winemakers and viticulturists that enter the SA wine industry are trained at the DVO. In April 2021, there were 161 undergraduate students in the DVO.

In 1995 the Institute for Wine Biotechnology (IWBT) was founded within the DVO for reasons already discussed in the historical overview section 3.2.3 of this chapter. It was a postgraduate training, and research institute focused on the biology and biotechnology of grapevine and wine-associated microorganisms. In 2013 another institute was established within the department, the Institute for Grape and Wine Sciences (IGWS), which operated through philanthropic funding from the industry. Its purpose was to strengthen teaching and research at the DVO/IWBT, interact with industry partners, and promote knowledge and technology transfer to the industry. The IGWS dissolved in 2019 due to the cessation of funding.

The DVO wanted to consolidate and simplify its structure. In 2018 the constitution for a new open (Type 2) research-intensive institute, The South African Grape and Wine Research Institute (SAGWRI) was accepted by the SU senate. It has since replaced the IWBT and hosted 82 postgraduate students[11] in 2021. The research activities of the DVO that were previously separate from the IWBT now also fall under SAGWRI. SAGWRI's vision is: "To deliver impactful and transdisciplinary research and training

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[9] Recommendations for appointments and promotions of academic staff in the Faculty of AgriSciences supplied by the Faculty of AgriSciences, Stellenbosch University

[10] Constitution of the South African Grape and Wine Research Institute at Stellenbosch University supplied by the Department of Viticulture and Oenology, Stellenbosch University

[11] Figures supplied by SAGWRI

in grape and wine sciences and to promote innovation" (Constitution of the South African Grape and Wine Research Institute at Stellenbosch University, 2018 p.1).

3.3.3.2 Funding

SAGWRI's research funding comes from various sources. In 2020 approximately 56% of its funding was from industry (local and international), indicating the importance of private funding in the sustainability of this institute and its founding department. See figure 3.4 for a division of SAGWRI's research funds.

The DVO environment is equally important to its main industry funder, Winetech (industry local). In 2020, of the 24 projects at SU funded by Winetech, almost half (11) were from the DVO/SAGWRI environment (Winetech Annual Report, 2020).

It is important to note that individual research projects are not always exclusively funded by one funder and that co-funding between two industry partners (local and international) or industry and government often exists, indicating the importance of funding leveraging in this environment. What is also noteworthy is the relatively large proportion of international funding (40%) that is attracted by SAGWRI, which can be viewed as international recognition for the high-quality research conducted by SAGWRI.

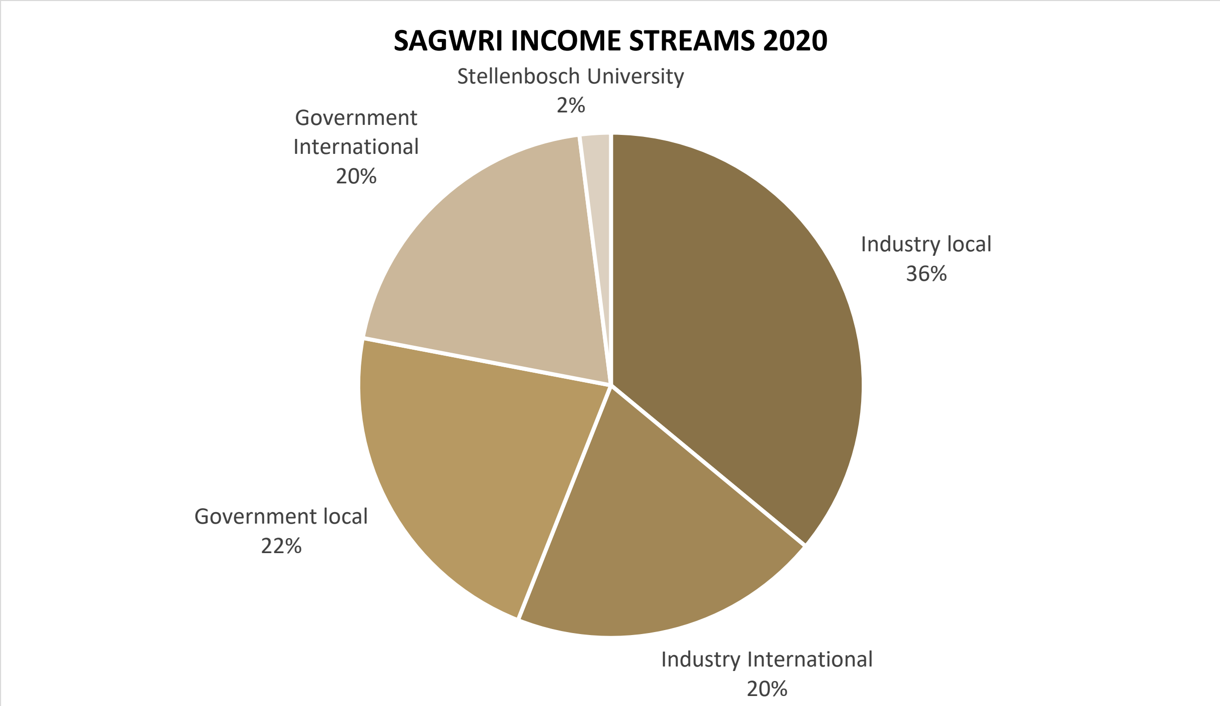

Figure 3.4: Income streams (rounded figures) for the South African Grape and Wine Research Institute during 2020. Source: Figures supplied by SAGWRI

In conclusion, the DVO plays a very central and crucial role in the total knowledge reservoir of the SA wine industry. The inter-relationships between Stellenbosch University (DVO/SAGWRI), the South African government (DSI/NRF/DHET) and the SA wine industry are illustrated in figure 3.5, with appropriate explanations. The next section of this chapter discusses the knowledge uptake of practitioners in general with reference to wine industry-related studies conducted in South Africa, Australia and the USA.

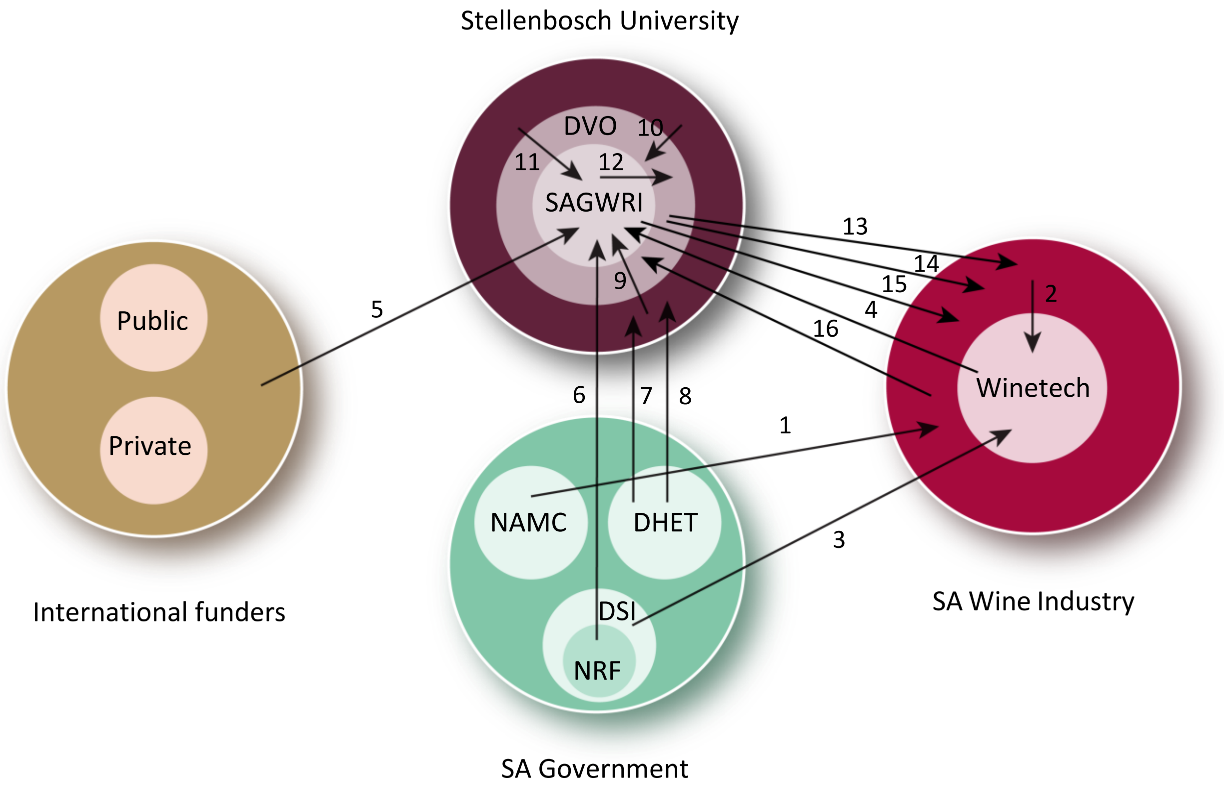

Figure 3.5: The university-industry-government relations of the South African wine industry, as informed by the Triple Helix Model (Etzkowitz & Leydesdorff, 1998). The model is specific for Stellenbosch University and the Department of Viticulture and Oenology, the study components of this thesis.

1. The National Marketing Council (NAMC) approves a statutory levy system for the South African (SA) wine industry to promote the sustainability of wine as an agricultural product.
2. SAWIS, on behalf of the SA wine industry, pays a percentage of the statutory levy received to Winetech. The wine industry communicates its research and knowledge transfer needs to Winetech.
3. DSI pays research money to Winetech to administrate on its behalf.
4. Winetech pays for research at the South African Grape and Wine Research Institute (SAGWRI). Winetech serves as the 'anchor funder' through which funding from other sources, local and international, is leveraged. Winetech enables the entire funding system.
5. International funders (public funds through bilateral agreements and private funding from commercial companies) pay for research at SAGWRI.
6. The National Research Foundation (NRF) funds research at SAGWRI.
7. Department of Higher Education and Training (DHET) provides input subsidies for all registered students at Stellenbosch University (SU).
8. DHET pays an output subsidy to SU for all scientific publications, books, book chapters, conference proceedings and graduated students. This is the most significant source of income for SU.
9. SU pays 10% of the received publication output subsidy of SAGWRI back to SAGWRI.
10. SU provides infrastructure and salaries to the DVO because of its various income streams.
11. SU appoints and promotes academic positions in SAGWRI based on academic footprint.
12. SAGWRI academics serve as lecturers for undergraduate teaching in the DVO. The greater the expertise (obtained through research) of the lecturers, the higher the standard of the undergraduate programme.
13. DVO graduates work as viticulturists and winemakers in the SA wine industry.
14. DVO provides ad hoc chemical analyses, sensory analyses and consulting to the SA wine industry.
15. SAGWRI research results are disseminated to the industry to increase practitioners' knowledge uptake and promote industry sustainability.
16. Industry sustainability promotes the availability of research funding for SAGWRI and enhances overall DVO sustainability.

3.4 PRACTITIONER KNOWLEDGE UPTAKE AND UTILISATION

Various factors determine whether practitioners will take up new knowledge, integrate it with the existing knowledge in their minds, and ultimately use it. As mentioned in chapter 1, practitioners do not necessarily categorise knowledge in their minds as either explicit or tacit and, with the explicit knowledge, what originates from scientific research (theoretical) and what is based on practical or experiential knowledge. They operate by utilising the whole reservoir of knowledge available in their minds. Practitioners' information-seeking behaviours also reflect their knowledge utilisation, as various studies amongst winemakers, for instance, have reported (Boshoff, 2014a; Hill & Hathaway, 2015; Szymanski & Davis, 2015). For that reason, the knowledge uptake literature in the following section describes knowledge in general (explicit and tacit) and not just scientific knowledge, as discussed in chapter 2. The generic insights this literature provides also inform the South African situation explored in the empirical study. This part of the chapter also has a stronger focus on wine industry-related studies to give a background on which this empirical study is built.

3.4.1 FACTORS INFLUENCING KNOWLEDGE UPTAKE BY PRACTITIONERS

In the knowledge production part of chapter 2, a section was devoted to the factors influencing academic engagement, i.e., the willingness of researchers to engage in knowledge-related interactions with practitioners. This section presents the flip side of the coin, i.e., practitioners' willingness to engage with researchers and the knowledge produced by research. It also includes knowledge engagement with non-academic sources.

According to the literature studied, practitioners' individual characteristics, the knowledge source's characteristics, the knowledge itself, knowledge transfer channels, and the role of intermediaries determine successful knowledge transfer, uptake and utilisation by practitioners. It should be noted that new knowledge is sometimes referred to as innovations or new innovations in the literature, and depending on which literature is cited, the terminologies will be used interchangeably.

3.4.1.1 Individual characteristics of practitioners

The literature emphasises that practitioners' individual characteristics can play a significant role in whether they will want to, or be able to, take up new knowledge. These characteristics can be personality, educational and experience-based.

- Learning intent - A practitioner's desire, will and commitment to learning something new is defined as learning intent (Tsang, 2002). Practitioners will be better prepared psychologically to understand and assimilate knowledge if they intend to learn from a source (Easterby-Smith, Lyles & Tsang, 2008; Pérez-Nordtvedt et al., 2008).
- Absorptive capacity - Practitioners must have the capacity to absorb new knowledge. Cohen and Levinthal (1990) define absorptive capacity as the ability to recognise the importance and value of new knowledge and then assimilate and apply it. Absorptive capacity is linked to the prior knowledge and experience of an individual. According to Park and Ghauri (2011), acquiring new knowledge is impossible without prior related knowledge. Therefore, prior knowledge and experience predetermine the level of familiarity and comfort with new information and its context, facilitating knowledge uptake (Lee, 2001; Srivardhana & Pawlowski, 2007). To demonstrate the concept: One could theoretically assume that a winemaker with a post-graduate degree has a higher absorptive capacity for new research results than a winemaker with only a bachelor's degree. This is because the former performed scientific research him- or herself and understands the scientific process because of experience. Another example would be a winemaker, who has experience in Pinot noir production, can potentially have a higher absorptive capacity for new knowledge on Pinot noir production than a winemaker who has never produced Pinot noir.
- Motivation and rewards – According to Kalling (2003), the stronger an individual's motivation is to learn, the more likely the individual will try to obtain new knowledge. There are two types of motivation, intrinsic and extrinsic (Al-Salti, 2011). Intrinsic motivation is when an individual obtains new knowledge because the knowledge is interesting and personally satisfying. Intrinsic motivation affects an individual's intention to learn and is not linked to organisational rewards. Extrinsic motivation is because of evaluation systems, company rewards, competition with peers and instructions from superiors. This can include monetary rewards such as bonuses, salary increases, promotions, and job security. Non-monetary awards can be in the form of certificates and public recognition. According to Bock et al. (2005), extrinsic awards often lead to learning.
- Values and beliefs – According to Davenport and Prusack (1998), an individual's values and beliefs determine what they choose to see or ignore. It also influences how much they absorb from what they choose to see. According to Rogers (2003), individuals will not expose themselves to new knowledge and innovations if it is not in line with their values and beliefs. Rogers elaborates that individuals will not assimilate new knowledge if it is irrelevant to their context.
- Innovativeness – Rogers (2003) categorises individuals based on their timing of adoption of innovations relative to others in the same social system. The five categories are innovators, early adopters, early majority, late majority and laggards. Innovators on the one end of the spectrum are

the most active information seekers, with probably the highest degree of learning intent and absorptive capacity. On the other end, laggards are the traditionalists, doing things the way they have always done and usually the last people to adopt new knowledge.

- Centrality – According to Hoffman et al. (2015), an individual with a high degree of centrality in a social network will be able to identify usable knowledge from other actors in the network. They will also be able to diffuse knowledge to more network actors, thereby creating more knowledge transfer nodes.

3.4.1.2 Characteristics of the knowledge source

The distance of the knowledge source from the recipient and the credibility of the knowledge source as perceived by the recipient, are important factors determining effective knowledge transfer. The 'distance' can further be divided into the geographical distance, organisational or cultural distance and knowledge base distance.

- Geographical distance - According to Cummings and Teng (2003), geographical distance influences the difficulty, time and cost of communication and thus knowledge transfer and uptake. The learning process is also more effective in interactive settings, especially in the case of tacit knowledge transfer, and is usually preferred over indirect communication (De Wit-de Vries et al., 2018). Information communication technologies (ICTs) such as the internet, emails, social media and mobile phone applications can overcome geographical distance. Research has, however, shown that ICTs could never replace face-to-face interactions through human social networks (Lubell, Niles & Hoffman, 2014).

- Organisational distance - The literature also refers to institutional factors or cultural differences between academia and practitioners. This cultural difference has given rise to Caplan's 'Two Communities' theory (1979). Researchers view themselves as knowledge producers and not necessarily as knowledge transfer agents (Dippenaar, 2017). They are also motivated mainly by the recognition they receive from the scientific community. As a result, most communication of new research results happens through scientific publications, conference presentations, and proceedings. Unfortunately, publications and conference proceedings are not the preferred way for the winemaking community to obtain new knowledge, as reported by various studies (Boshoff, 2014a; Hill & Hathaway, 2015; Szymanski & Davis, 2015). Winemakers mostly prefer to learn from their peers. Battistella et al. (2016) describe cultural distance as the degree to which a set of values and a shared vision create a common understanding of goals.

- Distance of the knowledge base – Cummings and Teng (2003) describe the distance of the knowledge base as the degree to which knowledge exchange participants have similar knowledge. Compared to the general public, there is a smaller distance between winemakers and wine science as a result of winemakers' formal training. Winemakers' professional knowledge overlaps with wine science knowledge (Szymanski, 2016b). Winemakers are therefore inclined to be interested in oenology research because of professional curiosity and development or the expectation that research results can be useful to them (Boshoff, 2014a; Szymanski & Davis, 2015).
- Credibility, reputation and social capital – Ko et al. (2005) describe source credibility as the extent to which a recipient of knowledge perceives the source to be reputable and trustworthy. According to various authors, trust facilitates knowledge sharing (Battistella, de Toni & Pillon, 2016; Rutten, Blaas - Franken & Martin, 2016; De Wit-de Vries et al., 2018). Trust increases with tie strength, the frequency of communication and interaction between entities sharing knowledge (De Wit-de Vries et al., 2018), say academia and practitioners. Trust and tie strength, collectively described as 'social capital', reflects a relationship's closeness. Recipients of knowledge are also more likely to trust knowledge at face value if the source has high credibility, rather than spending the time to check the knowledge for accuracy (Squire, Cousins & Brown, 2009). On the other hand, Park and Ghauri (2011) argue that the absence of trust can lead to misunderstanding, confusion and anxiety that can hinder knowledge transfer and uptake.

3.4.1.3 Characteristics of the knowledge

Practitioners evaluate various aspects of the knowledge itself when making the decision to take it up. It starts with whether the nature of the knowledge is suitable for the situation, followed by how it fits into their environments.

- Nature of the knowledge – Explicit knowledge can be codified, which makes it much easier to transmit between individuals (Polanyi, 1966). Tacit knowledge resides in people's minds and abilities. It is non-verbalised, intuitive and unarticulated, which makes it more challenging to transfer. It requires learning by doing and learning by using processes (Battistella, de Toni & Pillon, 2016).
- Perceived usefulness – According to Rogers (2003), an innovation has to offer some kind of benefit for an individual/firm/organisation for them to adopt it. Benefits can include convenience and satisfaction, economic factors and social prestige. Hill et al. (2015) identified increased productivity, sustained competitive advantage and improved workplace safety as three dimensions of perceived usefulness of new technology amongst Australian grape growers and winemakers.

- Complexity/ease of use – The complexity of an innovation is the perceived degree of difficulty in adopting it (Rogers, 2003). More understandable innovations are adopted more rapidly than innovations requiring new knowledge and skills. Increased knowledge can reduce complexity and facilitate effective innovation adoption (Davenport & Prusak, 1998). Australian grape growers and winemakers identified ease of use as an important consideration when adopting an innovation or technology (Hill et al., 2015).
- Observability – According to Rogers (2003), the likelihood of adopting an innovation increases when the innovation becomes more visible. It also enhances discussions amongst peers. Battistella et al. (2016) report that the ability to observe an innovation or to see its effects influences its assimilation.
- Timing – A survey by Hill et al. (2015) revealed that Australian grape growers and winemakers utilise knowledge encountered previously through various knowledge transfer channels only when the need arises. As previously mentioned, individuals will only acquire new knowledge if it is relevant to them (Rogers, 2003). One can argue that all winemaking knowledge is relevant to winemakers. However, this is where timing comes in. One of the questions this empirical study explored was whether SA winemakers take up new winemaking knowledge continuously as it becomes available or only take up new knowledge relevant to them at a particular time.

3.4.1.4 Knowledge transfer channels

Knowledge can be transferred in a unidirectional or participatory/interactive way, where the term knowledge exchange is more appropriate. Lubell et al. (2014) describe knowledge transfer channels as learning pathways, a term more applicable to practitioners' knowledge uptake. The authors refer specifically to how agricultural practitioners obtain information. According to them, the three pathways comprise technical, social, and experiential learning.

- Technical learning is achieved through reading print material, reading information on the internet, reading e-mail newsletters, attending conferences and seminars, and doing short courses. This type of learning correlates with unidirectional knowledge transfer.
- Social learning is achieved through workshops, study groups, field days, informal conversations on the phone and in-person with fellow practitioners, and conversations with consultants and suppliers of products and services. This learning pathway correlates with interactive/participatory knowledge transfer.

- Experiential learning is when practitioners try something themselves because of knowledge they obtained through technical or social learning. This is the final step in the knowledge uptake or innovation adoption process. The practitioner has internalised the new knowledge, found it potentially useful and aligned with their values and beliefs, and is now trying it out.

Interactive knowledge transfer channels are more effective in transferring contextualised knowledge, such as practical and tacit knowledge (Dippenaar, 2017). Unidirectional knowledge transfer channels are more important in generalised settings and transfer predominantly explicit knowledge. Winemakers utilise a combination of knowledge transfer channels based on their information-seeking behaviours (Boshoff, 2014a; Hill et al., 2015; Szymanski & Davis, 2015).

3.4.1.5 The role of intermediaries

Intermediaries facilitate knowledge and technology transfer amongst people, organisations and industries (Battistella, de Toni & Pillon, 2016). Examples of intermediaries are consultants and extension workers. They can be independent or work for boundary-spanning organisations. Such boundary-spanning organisations connect people with different types of technical and experiential knowledge to form social networks (Lubell, Niles & Hoffman, 2014), for instance, researchers and practitioners.

The most prominent role of intermediaries is to create awareness of new knowledge (often produced by academia), but evidence suggests that they can also facilitate the adoption of innovations (Lubell, Niles & Hoffman, 2014; Hill et al., 2015; Hoffman, Lubell & Hillis, 2015). Intermediaries can also validate the knowledge flowing through social networks (Dippenaar, 2017) to combat the spread of misinformation.

Suppliers can also be viewed as intermediaries since they communicate information about new products and processes (Hill et al., 2015). They provide technical knowledge and offer implementation support. Since suppliers are companies with the primary objective to sell and make a profit, the quality of the knowledge accompanying the new products or processes is sometimes in question. Practitioners can form strong relationships with trusted suppliers (Hill & Hathaway, 2015).

3.4.2 THE INFORMATION-SEEKING BEHAVIOURS OF WINEMAKERS

In addition to all the factors mentioned above that can influence practitioners' uptake of new knowledge, people also have personal preferences in how they do things. This section focuses on winemakers' information-seeking preferences and behaviours. Surprisingly, very few studies have been done globally to determine the information-seeking behaviours of grape growers, viticulturists, and winemakers. The four available studies are discussed, including the main frameworks they were based on and their main findings.

3.4.2.1 South African winemakers

Boshoff (2012, 2014a) investigated the use of scientific research by South African winemakers. His study had five objectives. The first objective was to establish the frequency of engagement of winemakers with traditionally viewed sources of scientific research. The second objective was to determine the scientific foundation of information sources that winemakers consult that are not traditionally viewed as sound sources of scientific research. The third objective was to explore how winemakers process information from a specific source, in this case, other winemakers. This objective was based on Rich's conception of research use: Information pick-up, information processing and application (Rich, 1997). Objective four investigated the prominence of the four types of research use among winemakers based upon a four-fold typology constructed from a combination of the typologies of Estabrooks and Weiss (Weiss, 1979; Estabrooks, 1999). The final objective was to establish the relationship between these four types of research use. The research was conducted via a quantitative web survey and qualitative interviews.

The study reported the widespread use of various information sources, with 90% of winemakers reporting conceptual use (better understanding) of research findings. 80% of winemakers said symbolic use, i.e., the science influenced their belief system, and 78% reported instrumental use, i.e., application. Popular articles of scientific research in *WineLand* magazine were cited as the most widely used source traditionally considered an accurate source of scientific research.

The study also demonstrated that information reached practitioners primarily from sources not traditionally considered carriers of sound scientific research, such as other winemakers (the most preferred source of winemaking information overall). Information obtained from other winemakers can contain a combination of technical knowledge, opinion, and experience. Some winemakers were consulted for scientific information more than others, acting as nodes in social networks. These nodal winemakers obtained most of their knowledge from industry technical events. Boshoff classifies the internet as an information source not traditionally considered a carrier of winemaking science. The internet as a knowledge source was investigated in the current empirical study.

Boshoff also hypothesises that 'knowledge creep' first described by Weiss, contributes to the types of research usage by winemakers (Weiss, 1978). In the case of winemakers, knowledge creep can be defined as the accumulation of knowledge from various sources (technical, social, experiential) over time, detached from its origins (e.g., original research projects). This knowledge serves as a reservoir from which winemakers can draw selected pieces of information that will influence their decisions on how to handle the specific situation.

3.4.2.2 Washington (USA) winemakers

Szymanski and Davis (2015) investigated the information-seeking behaviours and attitudes of Washington State (USA) winemakers and growers. The assumption on which they based their research was that winemakers and growers have reasons for their differential attitudes towards scientific information and that it is not necessarily because of ignorance as portrayed in the deficit model of science communication (Weigold, 2001). The authors conducted their research via semi-structured interviews and an online survey to a broader audience.

Washington is the second-largest wine-producing state after California in the US (Szymanski & Davis, 2015). Most of the wineries in Washington are small operations that produce only premium wines. The survey, therefore, differed from the SA study, which also incorporated winemakers from large producers making premium and bulk wine. The study found that Washington winemakers were highly heterogeneous in their information-seeking behaviours. However, the only two aspects they did agree on were the trustworthiness of traditional sources of scientific information such as textbooks and university extension and their disdain for seeking information via Twitter. Their heterogeneity could not be explained by their demographic characteristics, such as level of education and experience, for instance. It could be explained by their attitudes towards the role of science in winemaking and what it entails to be a good winemaker.

The researchers divided the different winemaker and grower attitudes (they were similar) into four subgroups based on the responses obtained in the surveys. This division was based on their modes of behaviour as described in the study of Danish scientists' attitudes toward communicating to the public (Horst, 2013). Szymanski and Davis (2015) believed that categorising winemakers (and growers) according to their attitudes can assist with tailoring knowledge transfer messages to their different drives. The four different subgroups were:

- Science-driven winemakers acknowledge that there is a right and wrong in winemaking, and they follow scientific recommendations. They read the *American Journal of Enology and Viticulture (AJEV)* and talk directly with researchers. They attend seminars but refrain from taking advice from just any fellow winemaker or suppliers of oenological products, as they view the latter two sources as not trustworthy in terms of accuracy. When encountering problems, they converse only with highly selected individual winemakers or groups of winemakers.

- Vision-driven winemakers believe one should follow your winemaking vision first and foremost. They don't think that right and wrong exist in winemaking. They believe scientific research is important but not always applicable to them. They like to take risks and believe that, as a result, they can make more interesting wines than science-driven winemakers that follow the safe scientific route. Vision-driven winemakers are open to learning from all sources, including science texts, trade journals, other winemakers, suppliers and social media.

- Utility-driven winemakers trust their experience first and do what works for them in their settings. They see value in scientific research but are not always sure of its feasibility in practical settings. They trust their own experience more than science. In comparison with the other groups, they place the least emphasis on continually educating themselves and are most likely only to seek information in response to encountering a problem. They are most likely to obtain information from other winemakers and Facebook and are more likely to distrust textbooks and extension resources.

- Pensive winemakers (there were only two) have strong technical backgrounds and value scientific research, although they believe it is largely irrelevant to their daily practice. They believe there are many possible solutions to a problem. Their primary information source of scientific research is *AJEV*, and their secondary source is other winemakers. They occasionally talk to suppliers as well.

The most popular source of information for Washington winemakers is other winemakers. The second most popular source is trade magazines in print form. *Wine Business Monthly* and *Practical Winery and Vineyard* are the most widely read. Winemakers attend seminars often since it offers face-to-face opportunities with experts to whom they can address questions. Washington winemakers occasionally use textbooks; surprisingly, 20% read *AJEV* often. They often contact extension faculty from Washington State University (WSU) and read extension e-mails. They prefer extension seminars and face-to-face contact with WSU faculty to the e-mail newsletters.

Suppliers as sources of scientific information are less popular, but the people who use them find them extremely useful. Washington winemakers view the internet as a poor source of winemaking information and rarely use it. If they do, it is to access the print trade magazines' online versions. The winemakers rarely use Facebook and Twitter as sources of winemaking information.

Szymanski and Davis advise that tailoring knowledge transfer activities to fit the typologies described in this research will make scientific facts more relevant for each group. In the case of science-driven winemakers, one must focus on the details and integrity of the science. With vision-driven winemakers, science must be portrayed as an option to achieve different wine styles. In the case of utility-driven winemakers, it is imperative to acknowledge the practical experience of the winemakers and highlight the connections between scientific fact and their experiences.

The researchers conclude that written communication often falls short in acknowledging people's practical experiences, hopes and concerns. Face-to-face contact can accommodate such issues but can be resource-intensive. By making written communication more appropriate for specific audiences, one can "offer a more palatable message and invite winemakers, growers, and scientists alike into a knowledge system in which both scientific and experiential knowledge are taken into account" (Szymanski & Davis, 2015, p. 285).

3.4.2.3 Study 1 of Australian winemakers

A study on the information sources and decision-making of Australian grape growers and winemakers differs from the first two studies discussed in that it was not an academic study. Results are given in the form of a report, *Adoption of grape and wine R&D outputs: Who what and why*, on the Wine Australia website (Hill et al., 2015). The investigation was done from a marketing-related angle rather than a knowledge transfer-related angle. The report, therefore, refers mainly to marketing-related academic publications on information-seeking behaviours. The Boshoff (2012) and Szymanski and Davis (2015) studies looked at information seeking for all knowledge usage types (including conceptual and symbolic use). In contrast, the Hill et al. (2015) study looked specifically at information seeking for selecting new technology or products (instrumental use). The research was conducted utilising qualitative interviews, and winemakers and grape growers were asked where they sourced information from and what they looked for regarding specific technologies and products (case studies).

The information source that had the most influence on practice adoption is other winemakers (Hill & Hathaway, 2015). Many winemakers, however, reported that they Google first to gather some information before seeking alternative information sources, which usually then starts with phoning someone such as a peer or a consultant (Hill et al., 2015). 95% of winemakers surveyed use the written material on the internet for information on scientific research. This finding contrasts with Washington winemakers' mode of action, which indicated that they rarely use the internet for scientific information (Szymanski & Davis, 2015). Australian winemakers' next most frequently used sources of scientific knowledge were industry organisation websites, peer-reviewed journal articles and regional association meetings and seminars (Hill et al., 2015). Some scientific information sources they rarely used included webinars, smartphone apps and social media. The social media result agrees with Szymanski and Davis' (2015) findings regarding Washington winemakers' reluctance to use social media for winemaking information. In the South African study, social media was not as prevalent when the research was conducted and therefore not investigated. It was investigated in the current study.

The Hill et al. (2015) study also found that in the case of simple decisions, winemakers will use experience and one or two external sources of information. In the case of more complex and risky decisions, the information-seeking will take longer, and winemakers will use various information sources.

The researchers refer to the information sources available to winemakers as their information horizon as described by Savolainen (2008), who described it as the way information sources are mapped in preference order in an imaginary field. This horizon can be different for different winemakers as well as for the type of information they seek.

The study also looked at the various factors that influence the information-seeking behaviour of winemakers and growers and their purchasing decision processes.

3.4.2.4 Study 2 of Australian winemakers

Given and co-workers (2016) did an exploratory study of interactive wine tasting seminars as part of a more extensive study: Information seeking and research adoption in the wine industry. Their research questions were how the Australian wine industry prefers to access information on new research findings, what strategies scientists use to communicate their research, and how effective the National Wine and Grape Industry Centre (NWGIC) wine seminars are as an information-sharing strategy.

The study was conducted via qualitative focus groups at four wineries with 25 winemakers and grape growers. An independent evaluation of the interactive wine tasting seminars of the NWIGIC was also done.

The study had various key findings. They found that the value of the co-created knowledge is reciprocal. Industry value face-to-face contact with researchers and prefer that information shared with them must be relevant to their region or situations. The tasting seminars identified possible barriers and facilitators to adoption for scientists and industry alike. The researchers also found that ongoing interpersonal relationships are vital for communicating new knowledge and eventual research adoption.

3.5 CHAPTER SUMMARY

The first part of this chapter provided a documentary analysis of the SA wine industry and SU, the DVO and SAGWRI. It gave an overview of the different role-players in the industry involved in winemaking knowledge-related interactions. It also provided information on the various income streams of SU and SAGWRI as critical factors influencing the academic engagement of the 11 oenology researchers interviewed in this study. It is clear from the information presented that the SA wine industry, SU and the SA government have a very intertwined relationship regarding funding and the resulting knowledge production and exchange. It is an ecosystem with many stakeholders, and the sustainability of the Department of Viticulture and Oenology and the SA wine industry depends on it.

The second part of the chapter provided an overview of the factors that can influence knowledge utilisation by practitioners in general, which were also explored in this study and reported on in chapter 6. The last part of the chapter focused on winemaker-specific research to compare results from the current study with previous studies concerning the specific practitioners investigated.

CHAPTER 4: RESEARCH DESIGN AND METHODOLOGY

4.1 INTRODUCTION

The empirical study explores knowledge exchange amongst certain South African wine industry population groups. During the investigation, the focus was placed on boundary-spanning activities (between academia and practitioners) identified in Chapter 1 of the thesis: collaborative and contract research, unidirectional and interactive knowledge transfer and the role of intermediaries. The study was conducted in four phases (Figure 4.1):

- Semi-structured interviews with oenology researchers of the Department of Viticulture and Oenology (DVO), Stellenbosch University (phase 1),
- An electronic survey of winemakers (phase 2),
- Semi-structured interviews with winemakers who participated in the electronic survey and agreed to be interviewed (phase 3), and
- Semi-structured interviews with oenology intermediaries (phase 4).

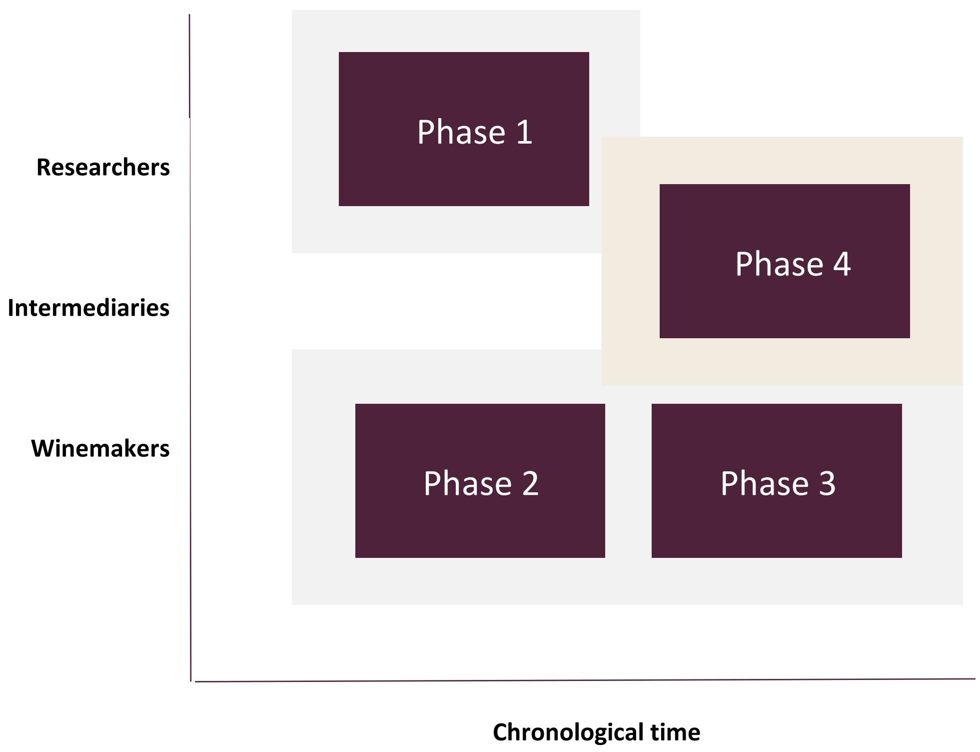

Figure 4.1: The four phases of the empirical study

Phases 1 and 2 happened first and concurrently, and phase 3 and 4 happened after phases 1 and 2. The reason was that phases 3 and 4 depended on results obtained in phases 1 and 2. Ethical clearance was obtained from the Research Ethics Committee (REC) of Stellenbosch University on 23 July 2019 (project 9508 - phases 1 and 2) and 6 May 2020 (project 14776 - phases 3 and 4).

The study examined three distinct but interconnected population groups in the South African wine industry: oenology researchers at Stellenbosch University, intermediaries specialising in oenological products and services, and winemakers. The study followed a mixed-methods design and is a case study of the winemaking-related knowledge interactions of the three population groups.

In the case of the winemaker group, an explanatory sequential mixed methods approach (involving both quantitative and qualitative components) was used (Creswell & Plano Clark, 2011). Such an approach has the advantage that a qualitative study that follows a quantitative study can explain the results obtained in the quantitative survey. The quantitative study determines the questions for which a more profound understanding is needed, especially in the case of surprising results. Quantitative results also allow the researcher to form groups and then follow up with purposeful selection for the qualitative phase (Chowdhury, 2015), which is how it was used in this study.

An exploratory, qualitative design was used for the researchers and the intermediaries. Qualitative studies explore the humanistic side of issues, which can often deliver contradictory opinions, emotions, beliefs, and behaviours (Chowdhury, 2015). Since an in-depth understanding of the specific social contexts of the three study groups was desired, qualitative research was the predominant method used.

The study was influenced by previous studies on which this research is built. This thesis generally builds on knowledge transfer and university-industry relations literature (researchers and specialised organisations or practitioner groups) rather than science communication literature (researchers and the general public), even though the line between these two audience types can be blurred and overlaps exist. An example of overlap is the factors influencing researchers' willingness to communicate with the public (Joubert, 2017) and the factors influencing academic engagement. Perkmann et al. (2013) define the latter as a term that refers to knowledge-related interactions between researchers and organisations (including industry actors).

In addition to the Perkmann and co-workers' scientific review, other recent academic engagement/knowledge transfer studies related to this empirical study include Ankrah, Burgess, Grimshaw and Shaw (2013), Banal-Estañol, Jofre-Bonet and Lawson (2015), Hottenrott and Lawson (2017), Muscio, Ramaciotti and Rizzo (2017), and Rajaeian, Cater-Steel and Lane (2018). At the time of writing, only one study related to the knowledge transfer activities of oenology researchers existed (Giuliani et al., 2010).

Scientific studies about knowledge uptake and utilisation by practitioners in the wine industry are limited. Studies relevant to this empirical study include (Boshoff, 2012, 2014a), (Dippenaar, 2017) and (Szymanski & Davis, 2015).

4.2 PHASE 1: INTERVIEWS WITH OENOLOGY RESEARCHERS

This phase of the study aimed to explore the industry engagement, as well as the factors influencing it, of oenology researchers at Stellenbosch University, South Africa. All the researchers that were indicated as “academic” or “researcher” on the DVO’s 2019 Contact List were selected for interviews (n=11). The 11 researchers were contacted via e-mail (Appendix 1) to obtain their permission to be interviewed and to arrange a date and time for the interview. The email explained the nature of the research. It was accompanied by the institutional permission to interview academic researchers of Stellenbosch University (Agreement on use of personal information in research, Service desk ID: IRPSD-1293, 1 July 2019), ethical clearance for the study (CREST-2019-9508, 23 July 2019), a declaration of consent form they had to sign (Appendix 2), and the proposed interview schedule (Appendix 3). All 11 researchers agreed to be interviewed and were subsequently interviewed. The data obtained, therefore, represents the entire group of academic oenology researchers at the DVO and not a sample.

The interview questions were grouped into four main themes: Research and funding, teaching and student supervision, industry engagement/knowledge transfer, and organisational factors. Age group and academic position were noted but later excluded in terms of analysing and reporting on the data since it could lead to the identification of some of the researchers. It should be noted that consenting to the interviews, the researchers did agree to be identified as a group, i.e., all the academic oenology researchers in the DVO, Stellenbosch University. Individual responses, however, had to remain anonymous, hence the exclusion of demographic data.

Interviews were conducted between 11 September and 18 November 2019. Eight interviews were conducted in English and three in Afrikaans. All interviews were face-to-face and recorded digitally using an iPhone 8 Plus. The iPhone 8 Plus is passcode protected. All voice recordings were immediately, after completion of the interview, backed-up to Google Drive and SU’s Microsoft One Drive, which are also password protected. The duration of the audio recordings ranged from 36 to 93 minutes. All audio recordings were professionally transcribed. Transcriptions were also backed up and password protected.

The data was analysed using computer-aided qualitative data analysis software (CAQDAS), ATLAS.ti. Such computer applications allow researchers to handle large datasets effectively by allowing faster and more precise processing (Chowdhury, 2015). However, the interpretation of the complex contextual meanings of the processed data cannot be done by any computer software and remains to be done by researchers against a specific framework.

The transcript texts were coded inductively but by keeping the main themes of the interview schedule in mind. Some codes were merged to reduce overlapping and redundant codes. Finally, 28 unique codes were created. It should be noted that coding was not done exhaustively since some of the answers given by researchers did not address the question that was asked. Sometimes, an answer was given but accompanied by lengthy non-relevant information.

Chapter 5 comprises the findings of this study phase reported according to an adapted Perkmann et al. (2021) academic engagement framework. The results are illustrated by relevant direct quotes where applicable. The results are discussed by comparing the researchers' responses to the background literature and academic engagement framework in Chapter 7 (Discussion and Conclusions).

4.3 PHASE 2: ELECTRONIC SURVEY OF WINEMAKERS

4.3.1 SURVEY QUESTIONNAIRE

A questionnaire (Appendix 4) to explore the information-seeking behaviours of South African winemakers was constructed, containing similar questions that were asked in two previous studies involving winemakers in South Africa (Boshoff, 2012, 2014) and the USA (Szymanski, 2016c) to be able to compare results.

The questionnaire comprised four sections. Section A, question 1 tried to establish how winemakers divide their time percentage-wise between all their potential responsibilities. Time spent on sales and marketing-related activities was a criterium used for the purposeful selection of winemaker interviewees in phase 3 of the study. The purpose was to establish if increased marketing responsibilities influenced winemakers' information-seeking behaviours. Question 2 was more focused on information type, and winemakers had to indicate how often they interact with oenology, viticulture or sales and marketing-related information using a 6-point response category system. This was to establish if they remained focused on winemaking, their core function, or if they tended to engage with other topics, they knew less about but need for their jobs.

The influence of different types of information relevant to winemakers on their information-seeking behaviours was not investigated in previous studies, which only focused on winemaking information and therefore represented a novel aspect to this study compared to similar ones.

Section B explored two issues concerning 36 sources of winemaking information. The information sources were divided into people, written materials and events. People and events represent interactive knowledge transfer channels, and written materials represent a unidirectional knowledge transfer channel.

The first issue explored was the frequency with which winemakers interact with different information sources.

- For *people* (question 3), a 7-point response category system was used: “about once a week”, “about once a month”, “about once every three months”, “about once every six months”, “about once a year”, “less than once a year”, and “never”.
- For *written resources* (question 4), a 6-point response category system was used: “about once a week”, “about once a month”, “about once every three months”, “about once every six months”, “about once a year”, and “never”.
- For *events* that happen less frequently (question 5), a 5-point response category system was used: “four or more times a year”, “about three times a year”, “about twice a year”, “about once a year”, and “never”.

Question 6 investigated how trustworthy, in terms of the accuracy of wine science, the winemakers perceived the information sources available to them to be, even if they do not make use of them. The four category response options were: “very trustworthy”, “generally trustworthy”, “sometimes not trustworthy”, and “definitely not trustworthy”. Various authors report that the credibility of an information source can facilitate knowledge sharing (Battistella, de Toni & Pillon, 2016; Rutten, Blaas-Franken & Martin, 2016; De Wit-de Vries et al., 2018), and it was, therefore, essential to explore which information sources South African winemakers deemed most trustworthy.

Question 7 comprised 12 statements about winemakers’ interest and behaviour towards relevant information. The winemakers had to rate each statement in terms of the extent to which they agreed or disagreed (“strongly agree”, “agree”, “indifferent”, “disagree”, and “strongly disagree”). Two statements that determine the participants’ interest in oenology research served as criteria for the purposeful selection of interviewees.

Question 8 explored the innovativeness of winemakers as classified by Rogers (2003), which also served as a criterium for the purposeful selection of interviewees.

Question 9 explored the centrality of the participants within the social network of South African winemakers by posing the question of how often they are contacted for advice by other winemakers ("at least once a month", "at least once in three months", "at least once in six months" and "never/almost never"). According to Hoffman et al. (2015), individuals with a high degree of centrality in a social network can diffuse information to more actors in the network, thereby creating more nodes of knowledge transfer.

Section C explored the connections (tie strength) between the winemaker participants and the academic researchers of the DVO. Tie strength is the frequency of communication and interaction between entities sharing knowledge (De Wit-de Vries et al., 2018). Tie strength increases trust; collectively, the two are referred to as social capital.

Section D, the last section, comprised various demographical questions regarding winemakers' formal qualifications, age, gender, job title, winery type and the region where the winery is located.

Finally, winemakers willing to be interviewed to explain their answers in the questionnaire could leave their names and contact details. Provision of winemaker details was voluntary.

The questionnaire comprised 20 questions compared to the Boshoff study (2012), which had 28 questions, and the Szymanski study (2016), which had 18 questions.

The questionnaire was converted to a web-based survey using SurveyMonkey, licensed for use by CREST at Stellenbosch University. None of the questions were compulsory, and winemakers could stop the survey anytime.

4.3.2 DISTRIBUTION LIST OF WINEMAKERS

The most comprehensive list of winemakers in South Africa is in the South African Wine Industry Directory (SAWID), an annual publication by WineLand Media. Until 2019 the SAWID listed winemakers and assistant winemakers in a separate list. The 2019 list contains 660 winemakers and 100 assistant winemakers (South African Wine Industry Directory, 2019). This list includes names of individuals that make wine on a small scale and *garagistes*, which renders it exhaustive. However, the list does not provide the professional email addresses of the winemakers. The directory also has a comprehensive list of producing cellars and brands with winemaker names but mainly lists the email addresses of the cellar or brand, not the winemakers specifically. It was therefore not useful for this study.

The database used for this study was the Winetech database that, at the time, comprised 534 winemakers and their direct email addresses. The Winetech database contained the contact details of the country's most important wineries and winemakers. It did not include the names of *garagistes*. The number of winemakers on the database was similar to the number of producing cellars (533) listed by the 2019 SAWIS statistics (South African Wine Industry Directory, 2021). Permission was granted by Winetech (Appendix 5) to distribute the electronic survey via Winetech's Mailchimp email programme containing the database. No personal information such as names and contact details may, according to the Protection of Personal Information Act of South Africa, be transferred to another individual or organisation, such as Stellenbosch University, without the written consent of the individuals in question. However, the principal investigator of this study is a full-time employee of Winetech and the database manager. The winemakers on the database have consented to being on the database and receiving emails from Winetech and the study's principal investigator. So, to avoid having to obtain the consent of 533 winemakers and to have a reasonable response rate, the Winetech Mailchimp programme was used to distribute the survey. The email was sent on 3 October 2019 to 534 winemakers with 529 successful confirmed deliveries. Mailchimp's open and click tracking was disabled on this campaign, as the responses had to be anonymous. The email explained the nature of the study, its anonymity as well as the rights of participants (Appendix 6). By clicking on the hyperlink that takes them to the survey, the respondents confirmed that they had read and understood the information provided and agreed to participate. The initial deadline for the survey was 18 October 2019, but it was extended to 18 November 2019. Two reminder emails were sent on 17 and 31 October 2019; open and click tracking was also disabled for these two email campaigns.

4.3.3 SURVEY RESPONDENTS

Of the 529 successfully delivered emails containing the SurveyMonkey winemaker survey link, 125 questionnaires were submitted, representing a 24% response rate.

4.3.4 SURVEY DATA ANALYSIS

The data obtained from the SurveyMonkey survey was directly exported to IBM SPSS, a software package for quantitative data analysis. The data was cleaned in the following ways: by deleting one respondent's data who only completed one question, by removing percentage signs next to numerical answers, and by tagging incorrect responses to question 1 (percentages not adding up to 100%). Two broad categories of data analysis were used: univariate and bivariate. The univariate analysis in the study consisted of frequency tables and custom tables and the bivariate analysis of crosstabulations between two different variables.

4.4 PHASE 3: WINEMAKER INTERVIEWS

4.4.1 PURPOSEFUL SELECTION OF WINEMAKERS FOR INTERVIEWS

Of the 124 winemakers who submitted usable questionnaires, 69 (56%) included their contact details, expressing their willingness to be interviewed in a follow-up study component. The 69 respondents' completed questionnaires were downloaded to an Excel spreadsheet, which was converted into a table to allow filtering for purposeful selection. Based on the responses of all 124 participants, the following five winemaker groups were identified for further in-depth exploration:

1. Winemakers who are very interested in oenology research results (labelled as 'geeks'),
2. Winemakers who are not interested in oenology research results ('eschewers'),
3. Winemakers who spend more than 20% of their time on sales and marketing activities ('marketers'),
4. Winemakers who regularly use intermediaries for information ('supporters').
5. Winemakers who are very interested in oenology research results and are under 40 years old ('millennials').

Twenty winemakers were selected in total, four per group.

For group 1 (Geeks): The first filter applied to the 69 participants included winemakers who agreed and strongly agreed to the statement: "I am interested in the latest oenology research at the Department of Viticulture and Oenology, Stellenbosch University." The second filter applied was for winemakers who also agreed and strongly agreed to the statement: "I am interested in the latest international oenology research." The third filter applied selected for winemakers that chose "Immediately try out the innovation" for the question: "When an innovation that could be applicable to you becomes available, what do you normally do?". The fourth and last filter applied was for those winemakers who selected "at least once a month" for the question: "How often do fellow winemakers ask you for advice," indicating their importance in the winemaker social network. These four filters delivered seven participants, of which four were available for interviews.

Table 4.1: Selection method employed for the 'geeks'

Question/Statement	Response options
I am interested in the latest oenology research at the Department of Viticulture and Oenology at Stellenbosch University.	Strongly agree + agree
I am interested in the latest international oenology research.	Strongly agree + agree
When an innovation that could be applicable to you becomes available, what do you normally do?	Immediately try out the innovation
How often do fellow winemakers ask you for advice?	At least once a month

Two of the winemakers in the group were in their forties, and two were in their fifties at the time of the interviews. Only one of them studied at the DVO. Three were senior/head winemakers, and one was a general manager/winemaker. Two winemakers worked at large production cellars at the time of the interviews, and the other two at an estate winery and a private cellar, respectively.

For group 2 (Eschewers): The first filter applied to the 69 participants included those winemakers who disagreed and strongly disagreed with the statement: "I am interested in the latest oenology research at the Department of Viticulture and Oenology, Stellenbosch University." This filter provided only two participants. It was then decided also to include winemakers that felt indifferent to oenology research at the DVO. The second filter that was applied was for those winemakers that selected "disagree", "strongly disagree", and "indifferent" to the statement: "I am interested in the latest international oenology research." These filters delivered nine participants, of which one winemaker who was also a CEO was excluded based on the assumption that lack of time because of his dual roles can influence his information-seeking behaviours. Of the eight participants, four were selected based on availability.

Table 4.2: Selection method used for the 'eschewers'

Question/Statement	Response options
I am interested in the latest oenology research at the Department of Viticulture and Oenology at Stellenbosch University.	Strongly disagree + disagree + indifferent
I am interested in the latest international oenology research.	Strongly agree + agree + indifferent
Which one of the following best describes your job title?	All job titles except CEO/winemakers

At the time of the interviews, three eschewers were in their thirties, and one was in his forties. One worked for a production cellar, two of them for private cellars and one for an estate/private cellar. Two held winemaker positions, one senior/head winemaker and one general manager/winemaker. Three studied at the DVO and one at Elsenburg Agricultural Training College. Two of the three who studied at the DVO have post-graduate degrees, meaning they have been part of the research process.

For group 3 (Marketers): The first filter that was applied was for winemakers who indicated that they spend more than 20 per cent of their time doing wine marketing and wine sales activities in the question: "In a typical year, what percentage of your working time do you spend on each of the following tasks?" The second filter applied was for the question: "Which one of the following best describes your job title?" This filter excluded winemakers who are also general managers, so the selection only included winemakers fulfilling marketing roles without the additional responsibility of being general managers. These filters yielded four participants, all of whom were available for interviews.

Table 4.3: Selection method used for the 'marketers'

Question/Statement	Response options
In a typical year, what percentage of your working time do you spend on each of the following tasks?	20% or more on sales and marketing activities
Which one of the following best describes your job title?	All job titles except General manager/winemakers

The four winemakers selected for this grouping indicated that they spend 20 – 50% of their time doing sales and marketing-related activities. Three were senior/head winemakers, and one was a production manager. Two were from production cellars, one an estate winery and one a private cellar. All four indicated that they consult sales and marketing information resources more regularly during a typical week than those containing winemaking and grape growing information. At the time of the interviews, two marketers fell in the age group 30-39, one in 40-49 and one in 50-59.

For group 4 (Supporters): The first filter used was to identify winemakers who answered "once a week" for suppliers to the question: "How often do you consult with the following people for new or existing winemaking information?" This filter delivered only two participants. The filter was broadened to include people consulting with suppliers once a month. This produced numerous names.

A second filter was applied for the question: "Which one of the following best describes your job title?" General manager/winemakers were excluded based on the assumption that the lack of time because of their dual roles can influence their information-seeking behaviours. These filters provided 13 names, of which some were already selected for other groups. Seven winemakers were contacted by phone, and four were available for interviews.

Table 4.4: Selection method used for the 'supporters'

Question/Statement	Response options
How often do you consult with the following people for new or existing winemaking information?	Once a week + once a month for suppliers
Which one of the following best describes your job title?	All job titles except General manager/winemakers

At the time of the interviews, two supplier supporters fell in the age group 40-49, one in 30-39 and one in 20-29, and they work for a production cellar, an estate cellar and two private cellars. They filled the positions of production manager, senior / head winemaker (two) and assistant winemaker.

For group 5 (Millennials): The first two filters that were applied were for winemakers under the age of 40 (filter 1) who agreed or strongly agreed to the question: "I am interested in the latest Oenology research at the Department of Viticulture and Oenology" (filter 2). This selection aimed to obtain a younger (millennial) view on preferred information resources as all four winemakers in group 1 were over 40 and considered opinion leaders in their social networks. Only one of these over 40 winemakers studied at the Department of Viticulture and Oenology (DVO). The third filter applied for group 5 was to select winemakers who obtained pre- or post-graduate degrees at the DVO and would therefore be familiar with the researchers at the DVO. Eight winemakers met the criteria, and four were available for interviews.

Table 4.5: Selection method used for the 'millennials'

Question/Statement	Response options
How old are you?	20 - 29 + 30 - 39
I am interested in the latest Oenology research at the Department of Viticulture and Oenology.	Strongly agree + agree
What is your highest oenology-related qualification?	B.Sc. Agric Viticulture and Oenology M.Sc. Agric Oenology International qualification

At the time of the interviews, all four millennials were between the ages of 30-39. Two worked at production cellars, one at a private cellar and one at a producing wholesaler. Two had B.Sc. Agric Viticulture and Oenology degrees, and two had M.Sc. degrees in Oenology.

The winemakers were all contacted by phone, explained the purpose of the interviews, and arranged a date and time to be interviewed. They were also reminded they willingly included their contact details to be interviewed. The winemakers were contacted in August 2020, eight months after they had completed their electronic surveys. The initial idea was to conduct the interviews directly after the South African harvest, which usually concludes by the end of April. However, due to the COVID-19 pandemic that resulted in South Africa being in a lockdown that severely restricted the movement of people, and Stellenbosch University prohibiting in-person interviews, the interviewing process was postponed with the hope that it would be allowed in the second half of the year. This did not happen as the pandemic was ongoing in the second half of 2020, and SU still prohibited in-person interviews.

The meetings were set up in Microsoft Teams (Appendix 7), SU's preferred online communication channel during the pandemic. It was accompanied by the proposed interview schedule (Appendix 8) and an SU consent form similar to the one the researchers signed and returned before their interviews.

4.4.2 WINEMAKER INTERVIEW QUESTIONS AND DATA ANALYSIS

The interview questions were divided into five main themes: general questions with regards to the winemakers' experience (to form a background perception of the winemaker's internal knowledge reservoir), preferred knowledge sources and why, how they find a solution to a practice challenge, how they learn about innovations and perceptions about academic research. The interviews were conducted in a semi-structured manner, which allowed for additional questions or probing where winemakers had interesting responses. Each winemaker's completed electronic survey also served as a framework for additional discussion points.

The interviews were conducted between September 2020 to January 2021. Two were conducted in English and 18 in Afrikaans. There were six female participants and 14 male participants. All interviews were recorded on Microsoft Teams and professionally transcribed to Microsoft Word documents. Interviews lasted between 29 minutes and 68 minutes. Interviews and transcripts were backed-up to password-protected Google Drive and SU's Microsoft One Drive.

The data was analysed using ATLAS.ti. The transcript texts were coded inductively but by keeping the main themes of the interview schedule in mind. To reduce overlapping codes, some codes were merged. Finally, 59 unique codes were created. Coding was not done exhaustively since some of the answers given by the winemakers did not address the question or were accompanied by irrelevant information.

Chapter 6 comprises the findings of the winemaker phases of the study. The results are illustrated by relevant direct quotes where applicable. A discussion that compares the results to the background literature in Chapter 3 is presented in Chapter 7 (Discussion and Conclusions).

4.5 PHASE 4: INTERMEDIARIES INTERVIEWS

4.5.1 SELECTION OF INTERMEDIARIES FOR INTERVIEWS

Ankrah et al. (2013) argue that most studies on academic engagement, and mostly the motives of individuals, have concentrated on academics and have not considered the motives of other parties involved. Industry actors were studied to a lesser extent and intermediaries even less. Intermediaries, however, play a vital role in academic engagement since they can facilitate the engagement process. This is why intermediaries also formed part of this empirical study to contribute to the novelty of this study.

Eight of the ten intermediaries were selected because they have post-graduate degrees in oenology, wine biotechnology or wine microbiology and currently work as either a supplier (of oenological products and services) or a consultant to winemakers in the South African wine industry. There are few intermediaries in the wine industry with postgraduate degrees, and they are well-known. Some of them were also mentioned by the winemakers. The post-graduate degrees implied they at some point had, or still have, a close relationship with the DVO. Their post-graduate degrees also indicated a better understanding of the scientific research process and the academic world since they were once part of it, compared with a person with only an undergraduate qualification.

The remaining two candidates were selected based on a mention by the interviewed winemakers and a close working relationship with the DVO. They do not possess post-graduate degrees but are actively involved in knowledge transfer with winemakers. Contact details were obtained from the Winetech database, which the principal investigator of this study manages. The intermediaries were contacted by phone to request permission to be interviewed. A meeting time was set up via Microsoft Teams, accompanied by a consent form for them to sign and return. All ten intermediaries agreed to be interviewed.

4.5.2 INTERMEDIARY INTERVIEW QUESTIONS AND DATA ANALYSIS

The intermediary interview schedule (Appendix 9) was divided into four main themes: general questions with regards to the participant's experience, questions about winemakers' information seeking and uptake behaviours, the participant's preferred knowledge sources and why, and perceptions about academic research.

Interviews took place between September 2020 and January 2021. Interviews took place via Microsoft Teams as SU still did not permit in-person interviews due to the COVID-19 pandemic. The interviewees were evenly divided between male and female, and all interviews were conducted in Afrikaans. Interviews were recorded via Microsoft Teams and professionally transcribed into Microsoft Word documents. All interview recordings and transcriptions were backed up to Google Drive and SU's Microsoft One Drive and password protected.

The data were also analysed with ATLAS.ti. As with the researchers and the winemakers, the transcript texts were coded inductively but by keeping the main themes of the interview schedule in mind. Like the previous two sets of interviews, some codes were merged to reduce overlapping and redundant codes. Finally, 35 unique codes were created. Coding was also not done exhaustively since the participants generally offered significant additional information outside the scope of the interviews. Especially the participants who worked for suppliers seemed to overemphasise their employers' expertise (self-promotion).

The results of the intermediary interviews are also presented in Chapter 6. Direct quotes support the results. Finally, the roles of the selected intermediaries, and intermediaries in the SA wine industry in general, are discussed and compared with the background literature in Chapter 7.

CHAPTER 5: FACTORS THAT INFLUENCE THE INDUSTRY ENGAGEMENT AND KNOWLEDGE TRANSFER ACTIVITIES OF SOUTH AFRICAN OENOLOGY RESEARCHERS

5.1 INTRODUCTION

This chapter presents the results of an exploratory study, with individual oenology researchers of the Department of Oenology and Viticulture (DVO), Stellenbosch University (SU), South Africa, as the unit of analysis. The study explored the 'world' of the community of oenology researchers and the factors influencing their propensity to engage with the South African wine industry. The empirical evidence was obtained from personal semi-structured interviews with the researchers as the primary source and analysis of documents related to the researchers as a secondary source. Reporting was supported by the codes generated by the computer-aided qualitative data analysis software (CAQDAS) programme, ATLAS.ti, as described in Chapter 4 of this dissertation.

The results of the current study build on two previous studies specifically. The first study is by Guiliani et al. (2010), who studied "Who are the researchers that are collaborating with industry" with a specific focus on the wine industries of Chile, South Africa and Italy. It is relevant because, given the time frame of when the study was conducted (October 2005 – October 2006), it is quite possible that some of the researchers interviewed in the current study were also interviewed. Secondly, the study followed the example of Rajaeian et al. (2018). They studied the *Determinants of effective knowledge transfer from academic researchers to industry practitioners* focusing on a specific applied research domain, i.e., the IT outsourcing decision support field. Most of the academic engagement/knowledge transfer-related literature reports on the behaviours of researchers from various disciplines, universities and even departments. This study also focused on a specific applied domain, i.e., oenology.

The results contribute to the academic literature on knowledge transfer, university-industry relationships / relations / cooperation / interactions / linkages, and academic engagement. It can also be viewed as contributing to the wider science communication literature, which involves knowledge-related interactions between researchers and society in general.

5.2 THE STUDY FRAMEWORK

Various factors can influence industry engagement and knowledge transfer by academic researchers. Perkmann et al. (2013, 2021) categorise these 'antecedents' into institutional factors, organisational factors and the individual characteristics of the researchers. Institutional factors refer to the affiliation with a specific discipline and the national setting regarding regulations and policies. Organisational factors refer to the researcher's direct environment, e.g., the department and the university. The individual characteristics refer to the researchers' demographics and motivations to engage with the industry.

The individual characteristics that can influence knowledge transfer activities, as described in chapter 2 of this dissertation, refer to researcher demographics such as age, gender, academic success, ability to attract funding and previous industry engagement. However, academic engagement can also be influenced by the intrinsic and extrinsic motivations of researchers (D'Este & Perkmann, 2011; Iorio, Labory & Rentocchini, 2017). This study specifically focused on the motivations of the 11 participants for three reasons:

- Individual motivations are underreported in the literature compared to demographic-related factors, thus justifying further investigation.
- Drawing meaningful statistical conclusions on demographics from such a small sample is impossible.
- Statistical data on demographics can also lead to the identification of the researchers, which is not allowed under the ethical clearance permission of this study.

The Perkmann et al. (2021) framework identified specific research needs, of which some were investigated in the current study. Figure 5.1 demonstrates the adapted analytical framework of the present study.

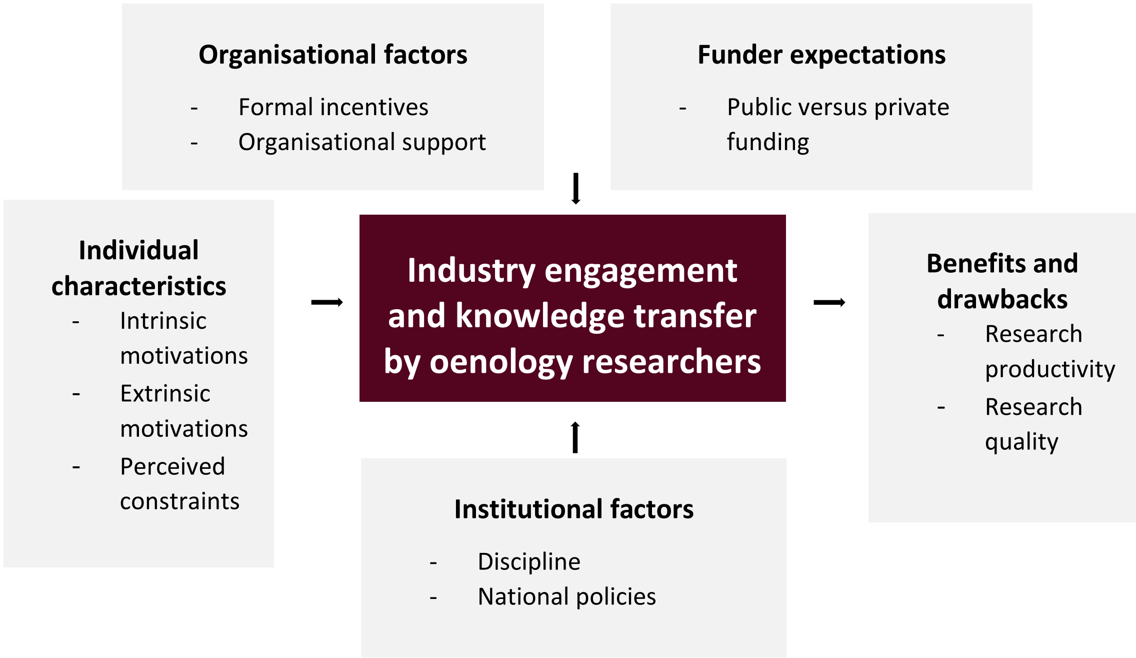

Figure 5.1: Analytic framework of the factors that influence industry engagement and knowledge transfer by academic researchers of the Department of Viticulture and Oenology, Stellenbosch University
Adapted from Perkmann et. al. (2013, 2021)

5.3 PRESENTATION OF RESULTS ACCORDING TO ELEMENTS OF THE STUDY FRAMEWORK

5.3.1 INSTITUTIONAL FACTORS

5.3.1.1 Discipline

All eleven participants had oenology-related research focus areas (the main criteria for their purposeful selection). Five participants reported that their research involves microbial organisms such as wine yeasts, wine bacteria, vineyard soil microorganisms or fungi. This finding is consistent with the fact that all five of these researchers were previously part of the Institute for Wine Biotechnology (IWBT) housed within the Department of Viticulture and Oenology (DVO) and whose focus was the study of wine-related microorganisms. They have retained their primary research focus as part of the newly established South African Grape and Wine Research Institute (SAGWRI). The other six participants reported their research to focus on various analytical chemistry and biochemistry-related aspects of wine processing and quality, mainly without the involvement of microorganisms. Two researchers mentioned having viticultural-related research projects as part of their portfolios.

Based on the participants' responses, one can argue that oenology, even though it sounds like a discipline within its own right, is, in fact, very transdisciplinary in that the study of wine involves microbiology, biotechnology, molecular biology, genetics, physics, cellular biology, analytical chemistry, biochemistry, sensory science, engineering, bioinformatics, data science and consumer studies. Most of these disciplines fall within the natural sciences field.

Natural sciences and agricultural sciences can differ in their closeness to application, with agricultural sciences generally viewed as more applied (higher practical relevance). According to Rip (2002), the combination of excellence and relevance is not present in all scientific fields and disciplines in the same way. One can argue that the natural science nature of oenology practised at the DVO can make the strive for a balance between excellence and relevance challenging at times.

5.3.1.2 South African national policies

Four participants mentioned the South African government output subsidy system for public universities as the driving force for the university's expectations of them. According to the participants, this is a national factor that drives certain organisational factors. Participant 3 explained that "Research that delivers good publications and graduate students" is "where they [SU] get the most money." Participant 6 agrees with this:

"Publication and churning out master's and PhD students because that is where the revenue comes from. That's where the government subsidies come from, and the money talks." Participant 6

Participant 4 elaborated on the subsidy system by explaining that SU gets the majority share of the subsidy and that the DVO only gets "10% as a department and its pro-rata*."* He explained further that the system is skewed:

"…because if you publish with colleagues overseas, the share is cut. If it's me, one of my students, and two other researchers from overseas on the list of authors, then we only get 50% of the money. So, it is a skewed system because it discourages you to collaborate. So, at the same time, there is a push for you to collaborate because it's great obviously for the name of the university." Participant 4

Participant 9 had the same criticism about the government subsidy system and international collaboration.

"If you look at research, you get a double message. You get a message about publishing via collaboration and publishing high. And then you get a message about, well, this is reducing your

subsidy. So perhaps you shouldn't do that. The subsidy is irrespective of the journal, and it's promoting single-author publications." Participant 9.

The National Research Foundation's (NRF) rating system for individual researchers emerged as another national factor that influences organisational expectations. This is significant to the study since the NRF rating system is based on academic output and academic standing amongst peers. Some participants mentioned that in the past, having an NRF rating gave researchers access to NRF funds; the amount was proportional to the specific rating. It was a good incentive for researchers to apply for a rating since these funds, to a large extent, used to be "discretionary." One of the criteria for promotion at SU is also a researcher's ability to attract funding. The NRF has stopped this funding attached to a rating; as a result, some participants viewed the rating as less important than it was in the past.

"I get the impression that even in South Africa, it means less and less every year. Because I know there was a good incentive, some years ago, because if you had this specific rating, you also received a certain amount of money each year." Participant 7

The participants were divided in terms of their opinions on the rating. Some saw it as very important to be considered for promotion. Others saw it as something the university expected from them, so they applied for the rating.

According to participant 8, "it is very important in the science world and the academic world. Sometimes it is one of the first things they look at."

Participant 8 added that even though a rating system like the NRF's is not used in Europe, it is something European funders understand and that a rating contributes to one's profile and status. It is beneficial when applying for funding via bilateral agreements between countries. According to her, it is a "must-have." Participants 1 and 9 confirmed the importance of a rating to obtain an academic position at the university and be considered for promotion.

"When I applied for the researcher position, for example, one of the questions you have to show, for your career, you have to be rated." Participant 1

"If you want to be considered for a promotion, you should really have a rating. Some departments have used it as a form of internal promotion." Participant 9

According to participant 9, the DVO does not use an NRF rating directly as a criterion for promotion. Participant 11 agrees that it is not used on a personal evaluation so much level but is essential for the university. For that reason, the university recommends it. According to her, the "number of rated researchers plays a role in how well rated the university is in general", especially since Stellenbosch University wants to be a research-intensive university. It is also pushed at the faculty level. Participant 4 explained why a rating was essential and recommended by the Faculty of AgriSciences:

"…to show how fantastic they [the faculty] are and then attract potentially more money from university central towards faculty because we are such big contributors to the university's image. So, it does play a role from that point of view." Participant 4

Participant 2 indicated that she has a "C" rating and that it is more "administrative", and that "it doesn't really change that much whether you have, or you don't have a rating." She does recognise it "as part of the system."

The main reason participant 3 applies for a rating is that, according to him, the university expects it from him.

"To be honest, it is not that important to me. I only do it because the university expects it from me." Participant 3 (translated from Afrikaans).

Finally, participant 7 felt that whether one is rated on the NRF system should not impede one's promotion. Because promotion "is based on the exact same criteria."

The significance of faculty and SU recommendations to researchers to apply for NRF ratings and even supporting them with the application can be seen as another indication of the university's strong emphasis on academic metrics. Being a "research-intensive university", such a recommendation to support its first mission is expected. The university's expectations in terms of social impact or its third mission were perceived as less important by the participants of this study.

5.3.2 ORGANISATIONAL FACTORS

"If you want to be seen as a professor, you must know more and more about less and less and less. And you must publish and publish and publish and publish in a research area that no one else has done. And it doesn't matter if it's just about the orientation of the hairs on the leg of a flea, as long as that is what you are publishing in and churning out post-grads. That is what the university takes seriously. So as far as the industry engagement thing goes, I think they pay lip service to it." Participant 6

Perkmann et al. (2013, 2021) report several organisational factors that can influence academic engagement in their systematic reviews of academic engagement literature. These factors include the academic quality (as measured by bibliometric metrics) of a specific department, the size of the department and the departmental peer effect. These factors were not investigated in the present study. This study instead focused on the organisational factors (barriers) as described in the science communication literature in the review by Jacobson et al. (2004) and more recently in the study by Joubert (2017) of publicly visible scientists in South Africa. Questions were structured to investigate whether these barriers were relevant to the 11 interviewed oenology researchers.

5.3.2.1 The university's expectation in terms of research type

This question assumes that applied research is closer to application, and researchers conducting applied research are more likely to engage with practitioners.

The participants commented that Stellenbosch University (SU) does not specify what research type (fundamental or applied) they should engage in or on what topic. They seem to have "academic freedom" in terms of these two aspects, as demonstrated by the responses of participants 2, 7 and 10 to the question: "What are the university's expectations in terms of the type of research you do?"

"Anything, as long as I graduated some students and published papers." Participant 2

"As long as I can do my work, it doesn't matter too much on what I do it." Participant 7

"I think the university accommodates both applied and fundamental research. I think the important thing is how you formulate it to make a good quality masters and a good quality PhD, I guess." Participant 10

According to these researchers, the only expectation the university does have is that their research must deliver at least "two peer-reviewed publications per year and graduate masters or PhD students".

5.3.2.2 The university's expectation in terms of research dissemination

Regarding research dissemination, the university's only clearly defined requirement seems to be scientific publication. The participants could not recall any clearly defined expectation that required or motivated them to disseminate their research results to practitioners or the general public. There also seemed to be different viewpoints as to whether speaking at or attending conferences was an important expectation from the university.

"It is not very clear to me. It is expected of me to write two peer-reviewed articles a year. That's the minimum. That's the norm for research. They don't say anything about conferences or contact or

transfer with the industry. They say nothing. As far as I know, I never got any indication." Participant 7

"The expectation from the university is that you will go to a conference a year and write two articles a year and produce two master's students or a PhD student." Participant 6

"The faculty looks at numbers of post-graduate students who graduated on a yearly basis as a performance area and the number of publications that are produced on a yearly basis. The conferences attended…maybe it's a supporting metric." Participant 9

Some participants believed the quantity of publications is more important to the university than the quality. On the other hand, others felt the university expects them to publish in journals with the highest impact factors possible.

"In the category where I am appointed, the expectation is 1.8 publications a year. Where you publish does not count that much. They only count numbers. In the evaluation you must submit every five or six years, I think there is a bigger drive to look at the impact, but within my appointment, it is not a priority." Participant 11 (translated from Afrikaans)

"The university's first requirement is to choose a journal with reputation. The university expects you to publish in a high impact factor journal. But they do expect you to lower your standards from time to time. We are in Africa. There are upcoming universities in Africa, and SU expects you to contribute to publication with upcoming universities." Participant 8 (translated from Afrikaans)

"Like any company, the university also has a vision. It has a position it wants to achieve in terms of research outputs and won't achieve it in the international arena if it doesn't push for quality." Participant 8 (translated from Afrikaans)

"This university tends to see itself as a university valuing excellence. And I think one of the measures they use is in the impact factors or impacts of the publications." Participant 9

Whether SU considers the impact factors of journals as an evaluation criterion, most participants felt that "scientific reputation is better served publishing in better quality journals." They inherently try to publish in journals with the highest impact factors possible to satisfy their intrinsic (feeling of being good enough) and extrinsic (recognised by peers and evaluation systems) motivations. As voiced by participant 7:

"I want to see if my work is good enough for them [reviewers of high-impact journals]."

Three participants mentioned that they consider the impact of their articles “to be more important than the impact of the journal, " recognising the shortcoming described in chapter 2 of the journal impact factor system.

Exploring the university’s expectations on scientific publication further, the participants were also questioned on SU’s policy and their personal views and experiences with open access (OA) publication since OA publication is a potential boundary-spanning activity that can help bridge the gap between researchers and practitioners.

Most of the participants indicated that they could choose whether they wanted to publish OA or not.

“There is an OA publishing fund that the library has that you can apply for funds up to like 50%, I think, of the funds for OA publishing of your research. But there are no policies. You can publish where you want to.” Participant 2

“I have never perceived a push from the university for us to publish open access. That is really my perception. The university might have a different opinion.” Participant 4

“No, I think this is very much an individual’s choice in terms of the choice of articles. The choice of journals. The choice of the form of publication. Open access or not open access.” Participant 9

Only participant 6 mentioned that OA publication is encouraged by the university and believes it is beneficial.

“Yes, it is encouraged, and I am extremely grateful when I get in an open-access journal because it means I get far higher hit rates. And we should be going for OA journals, in my opinion”. Participant 6

The participants also indicated that they prefer specific journals for reasons other than whether they are OA or not. According to participant 5, most of his publications are in OA journals because they are currently the most relevant journals for his field and the specific audience he is trying to reach. They include journals such as *Nature Scientific Reports* and the *PLoS* and *Frontiers* series.

The participants are all aware of the OA fund at SU library; some have used it to help subsidise the article processing charges of their OA journal submissions. All the participants who commented on OA publishing mentioned its exuberant costs. The money “has to come out of our research budgets” as the library research fund “only contributes 50% of the costs” and is “usually depleted by June each year”. To some, it is not worth the cost because, according to them, people who don’t have access to their publications can request it via ResearchGate or email.

"I would stick more to the journal itself. But there are some cases in which I did decide against certain journals because they are only OA, and they are quite expensive to publish, even though I know they are really, really, good journals." Participant 7

"You can get information very easily now. If you contact me through ResearchGate, I can send you the article, even if it is not open access. With open access, publishing fees are crazy. Who is making that money, not us? Do you really need to pay that huge amount of money when I can just send you the information? I am not sure if that is legal or illegal. I don't care. I think if you want information, you can get information. You write the authors, and you get it." Participant 1

Some of the participants mentioned that their funders don't have policies where they support OA publication. With the South African currency's weak exchange rate, OA publication article processing charges in Euro or US Dollars can be expensive. So, unless it is a journal the participants specifically want to publish in for its reputation, or if they happen to have access to funding for the APCs (research funds, SU library fund, DVO publication subsidy funds, or discounts because they review for the journal) they indicated they would continue to publish in paywall journals. Participants mentioned that they have no problems accessing paywall articles seeing that the Stellenbosch University Library has extensive journal subscription coverage. According to participant 5, "all the top universities in the world have adequate access to scientific journals" and "they don't need OA."

5.3.2.3 The university's evaluation system

In terms of yearly evaluations and evaluations for promotion, the participants indicated that "fundamental outputs" (number of publications and post-graduate students) carry the most weight. Undergraduate teaching and social impact count much less towards promotion, even though they comprise the university's second and third missions.

"The academic metrics are still the most relevant ones for the university for a good reason. We are knowledge generators, and how do you access the value of knowledge? It's the metrics, with all the problems that are linked to the metrics." Participant 5

"Promotion is subject to graduated students and the number of publications. They are the requirements of your job." Participant 2

In addition, participant 2 mentioned that one's "ability to attract independent funding" is an important promotional criterium. That can include industry funding. According to her, "no one cares about your lecture", echoing what other participants said about teaching as a promotional criterium.

Generally, it doesn't really matter that much or how much you lecture. It doesn't weigh as strongly." Participant 2

Participant 6 mentioned that undergraduate teaching and social impact do not carry the same weight regarding recognition as research outputs in the university evaluation system.

"I like teaching, but it doesn't get you anywhere in the university system. Teaching loads do not get you anywhere. It is not recognised as a contribution. You must do it because it is your job as a lecturer. You are a teacher." Participant 6

"The university likes to be seen to be engaging with the community. They like to be seen as having a social impact. But in fact, the university systems do not reward it. Because if they did reward it, I would be an associate professor by now. I would have long, long been an associated professor based on my social impact and teaching and learning contributions. But they don't." Participant 6

Elaborating on her statements, participant 6 explained that academics determine their yearly evaluation criteria (percentage weight allocated), comprising 20 – 40% "undergraduate, post graduate teaching and planning curriculum stuff, 30 – 45% research and 10 – 15% is service". Service can include being on committees around campus, peer reviews for journals and "social impact." Participants, however, had different opinions and understandings of what the university meant by a social impact.

Some participants spontaneously mentioned Stellenbosch University's "Research for Impact" policy which includes social impact. Those who did not mention it was prompted about it. The academic impact part was clear to the participants, but they differed in their opinions on the "social impact" part. Some believed it refers to outreach programmes to high schools or the general public. Others thought it relates to social upliftment with a transformation agenda – researching or training historically disadvantaged individuals because of South Africa's apartheid history. Some believed "community interaction" could include industry interaction; some were completely uncertain of what it meant.

The following responses demonstrate the participants differentiating views of what is meant by "research for impact" and "social impact" in the university's policy statements and evaluation system.

"There is definitely acknowledgement of community engagement, but not industry engagement, to the best of my knowledge." Participant 2

"It makes sense to have it [knowledge transfer to industry] as a KPA because community interaction, as far as I know, does not include practitioner interaction. It's more social upliftment type." Participant 2

"I am not sure. Obviously, they [SU] want you to present at conferences, but those would be specific scientific conferences. If I write there that I presented at the Shiraz Association [practitioner organisation], I don't think it will count anything for the university." Participant 3 (translated from Afrikaans).

"Must the impact be for the field or society? It's two different things." Participant 3 (translated from Afrikaans)

"I think it's everything. So, it's scientific excellence and impact on the industry. I think it's both. Industry and obviously its societal aspects within the South African context." Participant 4

"We at the faculty are clearly connected to some industries. So, there is some kind of expectation that we will interact with this industry, and we will make sure that impact falls in this industry." Participant 4

"There is some kind of expectation that you have some social impact. So that includes engagement with the industry. So, there is some kind of expectation, but it's not written. I don't think it's very clearly spelt out." Participant 4

"And it includes your social impact, like your Garagiste short course [university short course for home winemakers], or whatever. And it includes the fact that you've gone and spoken at industry talks." Participant 6

"I have no idea. That's the thing. This is the part of the policy that I am completely unclear on." Participant 7

"You need to be involved in some sort of social development activities, teaching at high schools, giving students special programmes at the Pinotage Youth Academy [training for previously disadvantaged individuals]. But it's not pushed actively in some people's portfolios. So, I don't have much of a social impact. My focus is on research." Participant 9

"It's caused a lot of controversies because social impact, I mean, what do you define as social impact?" Participant 9

"As part of your work agreement, there is a part that relates to community interaction. The wine industry is a community where all of us have a percentage to work in the community." Participant 11 (translated from Afrikaans)

Participant 5 mentioned that social impact includes the university's commercialisation and spin-off endeavours. He also referred to the research conducted by the Humanities department, on gender-based violence, for instance, can be seen as 'social impact' since the research is conducted with close industry contact.

Participant 8's understanding of the "Research for Impact policy" is that as a researcher, it is essential to publish in good and even top journals. It also means that researchers must impact their communities, such as the South African wine industry. Participant 3 thinks the university sees mostly good publications and student output as "impact" and that the term research for impact is "vague" in terms of describing the university's expectations from its researchers.

Participants 6, 9 and 10 indicated that they are not recognised or incentivised to disseminate research results to industry practitioners. Participant 6 said that they are, in fact, "discouraged" from engaging with the industry since they must pay for themselves to engage with the industry and that it can be expensive if it is an industry conference, for instance. It is clear from these responses that greater clarification is needed in terms of this specific university policy and how it can be implemented by different university departments and even different individuals. It covers various aspects of involving the community; not everything will suit every department and individual. A good starting point would be to get rid of the confusion and then give direction that is departmental and individually focused.

5.3.2.4 Knowledge transfer training

The participants were asked whether they had received any training on communicating with audiences other than academic audiences, i.e., practitioners or the general public. If not, they were asked if they were aware of any such training being offered by the university. These two questions are significant since "lack of institutional training on knowledge transfer (KT) to non-academic audiences" was identified by some participants as a constraint to their knowledge transfer actions with industry. A striking result is that none of the 11 participants has received any knowledge transfer/science communication training during their careers at SU. This result does not necessarily imply that the participants are not skilled in writing plain language articles and doing presentations to the industry. Participant 6 felt she "can write anyway", and participant 11 thought she had a "natural feeling" for KT to industry audiences. However, this does not mean it cannot "be improved upon." Participant 4 indicated that his KT skills are "self-taught." Their perceptions of their abilities are not ill-conceived since all three participants have written various plain language articles for *WineLand*[12] magazine. The

[12] https://www.wineland.co.za/

fact that the articles passed review from the editors indicates that they were suitable for non-academic audiences.

Most of the participants were aware of communication courses offered by die university. However, they did not think these courses provided training on communicating with practitioners. They mentioned the Language Centre[13] and the Post Graduate Office[14]. However, judging from the information presented on the websites of these two entities, both offer courses related to academic writing and academic presentations only. This aspect was voiced by participants as well. Participants 9 and 11 mentioned CREST[15] (Centre for Research on Evaluation, Science and Technology). CREST offers a short course in Science Communication, which focuses on researchers communicating with society, which would be the most applicable for learning skills on communicating with practitioners.

According to participant 6, she has seen regular invites from the university on courses in writing, mostly thesis writing. These invites are usually aimed at "young researchers," which she finds off-putting:

"I look at this, and I go… I don't want to go there and be the 'Ouma' [grandmother]." Participant 6

Participants 7, 9 and 10 felt that KT training is vital for students who leave academia after completing their post-graduate degrees. If such training courses were available, they would motivate their students to attend them.

"90% of people are going to leave academia, and then they don't have those soft skills, but I think they should. Maybe they don't have them, and they don't see them as important because nobody puts it to them like that or demonstrates them. Because explaining is one thing but kind of demonstrating, like putting them in the situation of having to explain or talk about your work in front of people who are not from the same background as you." Participant 7

"I think that the university could invest better and invest more in this kind of training." Participant 10

Participants 2 and 3 mentioned that the university offers training in PowerPoint presentations to academics, but it is more focused on scientific communication and lecturing. Participant 2 commented that it has helped her make her slides look "pretty" but that it is "not necessarily focused on public communication."

[13] https://languagecentre.sun.ac.za/

[14] http://www.sun.ac.za/english/research-innovation/Research-Development/postgraduate-office

[15] https://www0.sun.ac.za/crest/

Participant 8 felt she wouldn't send her students for such training if available. According to her, students must master so many things during their master's degrees, such as thesis and scientific article writing, that there isn't time for teaching them KT skills.

"The reason is not that I am against it [KT training]; there are so many things they need to master that, for me, it is something that should come after their studies. They must overcome so many hurdles before they can get to PowerPoint presentations. The standard is high. We even expect a publication from an M student. That is a lot to ask to reach the level where you can publish in a scientific journal within two years." Participant 8 (translated from Afrikaans)

Participant 11 felt that KT training should always be voluntary since not everyone has a "knack" for it or wants to do it. According to her, people can have "strong opinions" about it. She sees the importance of such a "soft skill" and speculates that more people would probably consider it if the training were available.

5.3.2.5 Teaching and student supervision

Teaching, which includes post-graduate student supervision, is considered one of the two original missions of universities. According to the participants, all researchers in the DVO must spend some percentage of their time lecturing to undergraduate students and supervising post-graduate students. It is one of the ways researchers can transfer academic knowledge. Also, the amount of time spent on teaching and supervision is an organisational factor that can influence time spent on the university's first and third missions, i.e., research and societal engagement. The 11 participants were asked how they perceive their teaching load and how they feel about teaching.

Participant 1 enjoyed teaching to the point where he would like to teach more.

"I am appointed as a researcher, so teaching is not my main activity. But I am interested in teaching and would like to teach more. I will be very happy if I can teach the whole module and not 60% only." Participant 1

Participant 4 also enjoyed teaching but despised the administration that accompanies it.

"I enjoy lecturing, so the contact with those students during a lecture, I enjoy. The side aspects of teaching I don't like at all. The marking is a nightmare for me. I procrastinate as much as I can. These kinds of things, all the admin that is connected to teaching, I hate it. Absolutely hate it." Participant 4

Participant 7 found it challenging to juggle research and teaching even though she did enjoy teaching, which in her case comprises mainly post-graduate supervision.

"I do see it as a very involved activity. So, it's a bit draining because I really like to go kind of all in. But I do really enjoy it, but I think it is a job unto itself. So, this thing of trying to combine it with research is great if you have time for both. It is not that easy to jump from one to another." Participant 7

Participant 10 pointed out a challenge she experiences with post-graduate supervision: the abilities of students from universities other than SU. Some of them lack the skills one would expect from a master's or doctoral student and therefore require more hours of supervision than a SU-trained student. For that reason, she does not take on that many post-graduate students.

"She couldn't even use a pipette when she came in, you know. So those kinds of basic things have made me not want to take too many students." Participant 10

Two of the participants indicated that they also lecture in the natural sciences faculty of SU even though the DVO falls under the Agrisciences faculty of the university. This is purposefully done since the type of biotechnological research these two researchers conduct requires students with a natural science background. One participant indicated that up to 90% of his post-graduate students come from the Faculty of Natural Sciences. This finding ties in with the reported nature of the research conducted by most of the researchers interviewed, mainly that of a natural sciences nature.

Despite some challenges, the participants generally felt positive about teaching and supervision as part of their job descriptions at the university. None of them saw it as something they would prefer not to do to spend more time fulfilling the university's other missions. One can argue that, like for research, teaching policy is clearly defined, whereas knowledge transfer to non-academic audiences is not.

5.3.3 FUNDER EXPECTATIONS

Research funding can either come from public (governmental) or private (industry) sources. Results from documentary analysis of SAGWRI, the research institute within the DVO, revealed that more than 50% of its research income in 2020 was from industry funding. The current study showed that the source of research funding could be an important factor influencing researchers' propensity for industry engagement. This factor was not covered in the existing Perkmann et al. (2021) framework.

5.3.3.1 The main research funders of SAGWRI

The participants mentioned six different funders by name and one group referred to as "commercial companies" (Table 5.1).

Table 5.1: Oenology research funders and programmes mentioned by the 11 research participants

Funder name	Funder type	Country of origin
Wine Industry Network of Expertise and Technology (Winetech)	Industry	South Africa
Department of Science and Innovation (DSI)	Government	South Africa
National Research Foundation (NRF)	Government	South Africa
Technology and Human Resources for Industry Programme (THRIP), Department of Trade and Industry (dti)	Government	South Africa
The Royal Society	Learned Society	United Kingdom
Lallemand	Industry	Canada
Commercial companies	Industry	International
Stellenbosch University (Early career development programme)	University	South Africa

Winetech, as an industry funder, has been described in detail in Chapter 3. Winetech receives and manages the statutory research levy paid by all South African wine grape, wine and brandy producers. Winetech funds academic research related to grape growing and winemaking and funds various departments and institutes within SU. The Department of Viticulture and Oenology (which includes SAGWRI) is the department at SU that receives the most funding per year from Winetech (Winetech, 2020a). All the participants indicated that they were either current or previous recipients of Winetech funding.

The Department of Science and Innovation (DSI)[16] is the South African government department responsible for science, technology and innovation. Researchers can obtain funding for their research from the DSI via Winetech. Winetech applies for funding for a certain period from DSI and then allocates the funding to selected projects that meet the criteria as set out by the DSI. Winetech manages the research progress through its committee system and reports to DSI. In the past, research projects could be up to 100% funded by DSI, but in the most recent funding cycle, DSI agreed to pay only 50% of the project costs, with Winetech having to subsidise the rest. At the time of the interviews, three researchers received funding from the DSI (Winetech, 2020b).

The National Research Foundation (NRF)[17] is an independent South African government agency. According to its website: “The mandate of the NRF is to promote and support research through funding, human resource development and the provision of the necessary research facilities to facilitate the creation of knowledge, innovation and development in all fields of science and technology, including indigenous knowledge, and thereby contribute to the improvement of the quality of life of all South Africans.” The NRF is an intermediary between the government's (DSI) policies, strategies, and research institutions. Researchers apply directly to the NRF for project funding, student bursaries and individual researcher ratings. Seven participants mentioned that they either currently or in the past received NRF funding.

The NRF rating system is a benchmarking tool to rate the quality of South African researchers. Ratings are based on the researcher’s recent research outputs and impact as rated by local and international peers.

In 2006 the Department of Science and Innovation and the NRF established the South African Research Chairs Initiatives (SARChI). The main goal of these Research Chairs is to improve public universities' research and innovation capacity for producing high-quality research outputs, innovations and post-graduate students. A Research Chair appointment is usually accompanied by significant funding for five years. After five years, the recipient’s output is evaluated to determine whether the Chair should be appointed for another term or not. One of the participants in this study is a SARChI Research Chair recipient.

The Technology and Human Resources for Industry Programme (THRIP) is a cost-sharing grant between the South African Government Department of Trade and Industry (dti) and industries that

[16] https://www.dst.gov.za/

[17] https://www.nrf.ac.za/

work with academia. The shared funding is for research and development in science, engineering and technology to produce technology solutions and highly skilled human resources to improve industry competitiveness. In the past, DVO researchers received ample THRIP funding. At one point, the funding matched the funding obtained from Winetech 1:1. However, access to THRIP funding has become more and more difficult for DVO researchers to the point where only one of the 11 participants reported having access to THRIP funding at the time of the interviews.

The Royal Society is a learned society in the United Kingdom. It is the oldest scientific academy in continuous existence (established in 1660). It funds academic research throughout the world, including Sub-Saharan Africa. At the time of the interviews, one of the study participants was funded by the FLAIR fellowship programme, a partnership between the African Academy of Sciences (AAS) and the Royal Society, supported by the Global Challenges Research Fund.

Lallemand is a family-owned Canadian company that specialises in developing, producing and marketing bacteria, yeasts and their derivatives. Lallemand provides microbial solutions for various industries, including the wine industries of the world. One of the participants mentioned Lallemand as his primary funder at the time of the interviews.

Over the years, various commercial companies have funded contract research at the DVO, as mentioned by one of the 11 participants.

One participant mentioned that he received funding from Stellenbosch University given to graduated PhD students who start their academic careers.

5.3.3.2 Industry funding dependence

Participants were asked if they thought the DVO was dependent on industry funding. The reasoning behind this question was that most of the expectations for industry engagement and knowledge transfer come from the industry. So, if industry funding were not needed to ensure the sustainability of the DVO, it would theoretically allow researchers to pursue research projects better suited to fulfil the university's agenda of maximum scientific output. Researchers won't be expected to spend time engaging with the industry or provide plain-language articles and present at industry seminars. One can hypothesise that adequate public funding could be more beneficial to their publication output and NRF ratings, which can be more beneficial to their careers.

Participants were divided in terms of their perceptions of the DVO's dependency on industry funding. Participants 1 and 4 felt the DVO depends on industry funding, whether local (SA wine industry) or international. Participant 6 was unsure. She mentioned the Winetech funds were "drying up", and whilst it used to be very important in the past, she was uncertain of how important it was at the time of the interviews in terms of the sustainability of the department. Participants 8 and 11 felt that with the "current research focus", the DVO is dependent on industry funding. Should funding disappear or become very limiting, other options for funding do exist through, for instance, European funding and consortia. This will result in the DVO research becoming more "fundamental" in nature. They, therefore, don't see the DVO as dependent on industry funding.

"Without industry funding, our focus will shift to fundamental research. That the department will continue without industry funding, for sure, just like many fields at the university that are not linked to industry. It is the exception to be linked to industry. So, it will just be a reorganisation and shift in focus. I think the research themes covered here, like molecular plant biotechnology and yeast, are internationally fundamental in nature. Currently, we are trying to move two lanes forward. It is easier or more difficult for some people in their field, depending on their field, but it is fundamentally academic, and they will run with it." Participant 8 (translated from Afrikaans)

5.3.3.3 Funder expectations in terms of research type

In Chapter 2, the two broad categories of research type were discussed, i.e., basic/fundamental and applied (Calvert & Martin, 2001; Calvert, 2004, 2006). Despite the many shortcomings of such a rigid classification system, the terminology remains in use because it allows the researcher and funding organisations to describe the nature of research projects. The participants were asked their funders' expectations regarding their research type.

They mainly commented on the expectations of Winetech, the primary industry funder, and the NRF, the main public funder, over the past few years. Two of the participants also commented on commercial companies' research expectations.

As demonstrated by the comment below, it was clear that Winetech has particular expectations regarding the relevance and applicability of the research for the industry.

"I think they are looking more to applied research or research that can have a clear application or benefit to the industry. It makes sense thinking of Winetech, an industry-based institution, that whatever Winetech generates is to the benefit of the industry and not just to the benefit of science or academia." Participant 1

Various researchers also indicated that even though Winetech has always preferred applied research over basic research, there has been an increased requirement for even more applied research that falls within specific themes specified by Winetech. The NRF and The Royalty Society seem to be less stringent in terms of conducting research with a direct application and are more supportive of basic research and academic freedom, as the following quotes demonstrate:

“Winetech requires me to do very applied research, whereas other funders are more flexible in terms of allowing me to pursue topics that are more of fundamental scientific interest that do have applications that fit within the strategic development goals of Africa for global sustainability goals, but that can be long term.” Participant 2

“So, with public funding, you have a lot more freedom to pursue basic research. With industry funding, there is an expectation that you produce research that has applications in line with what industry is focused on.” Participant 9

One participant alluded that Winetech’s view of what applied is and what researchers view as applied can differ, influencing the outcome of a project application.

“Winetech has gone through some changes. They ask for more and more applied research. But my issue is honestly, like what maybe we see as applied research and what they see as applied research is not always the same.” Participant 7

Another participant made a comment that demonstrated the particular focus of Winetech in terms of what it wants and how it influences whether she will apply for funding from Winetech or the NRF, which allows a broader spectrum of research types.

“Winetech has themes. So I have to look at the theme and like… what is the chance of this one making it..you know…for like because I always feel like… ah, it’s pointless if I force something into a theme.” Participant 10

In contrast to Winetech, which is very specific regarding applied research outcomes, the NRF seems more open to curiosity-driven research. However, it appears that the NRF is starting to emphasise societal relevance because of national policies, as mentioned by one participant.

“They are a research body established to fund primarily fundamental research.”

“The NRF looks at relevance measured by various parameters, which include the academic metrics primarily. Student output is a major factor for the NRF.”

“But also, relevance, they want to see industry interaction. They want to know what’s going on there. It has become more important for the NRF over the past few years to focus on relevance. There is obviously some political pressure.”

"The NRF does realise that they are the only body now within the South African context that can support this broad range [basic and applied] of research." Participant 5

The participants report that the commercial companies require predominantly applied research but that one company also allows for a combination of research types.

"They [commercial companies] are interested in developing something directly applicable in industry." Participant 11 (translated from Afrikaans)

"What I like about them [commercial company] is that there's always a combination of career-driven and applied outcomes to the research they fund. They see the university as an independent research institution, and we generate results for them. We generate research results…they fund the research, of course, they expect some kind of return on investment, but they ask universities in general to do the research as a guarantee of integrity and independence." Participant 4

It can be concluded from the participants' responses that the main industry funding body, Winetech, has become very prescriptive in terms of the type and topic of research projects it will consider for funding. This is a change from when Winetech first started to fund the IWBT over 20 years ago when funds mainly were "discretionary" (participant 5). The NRF, on the other hand, being the primary source of public funding over time, funded mostly basic research. This seems to be changing as the NRF start to require industry relevance in the research projects they are willing to fund.

5.3.3.4 Funder dissemination expectations

The participants commented on four funders and their research dissemination expectations: Winetech, the NRF, The Royal Society and Lallemand. Five dissemination actions were mentioned: progress reports, scientific publications, conferences, industry seminars and popular articles.

Documentary analysis revealed that both Winetech and the NRF require the anticipated academic outputs and non-academic outcomes of the project in their formal project applications, which can therefore be interpreted as funding criteria.

Winetech requires researchers to list the "Likely publications (popular, press releases, scientific)" and "Presentations/Papers that could be delivered" on their online new project submission system (supplied by Winetech R&D manager, 2021).

The NRF describes anticipated outputs as follows:

"This refers to the envisaged output ("product") of the research project in line with the Funding Instrument objectives and may take the form of publications, public presentations, data, patents, artefacts, exhibitions, design, etc. The outputs should be detailed and quantified as far as possible." NRF online submission system, March 2021 (supplied by participant 4)

Participant 10 confirmed the requirements from the funders with her comment that both the NRF and Winetech require communication of research results beyond the academic community in the form of science communication to the general public and popular articles and presentations for the wine industry.

Participant 7 agrees with these expectations from funders but feels that these expectations are not always clearly defined. When applying for research funding, she would conservatively list possible outcomes but then, in the end, try to deliver more. It depends on the type of project of how much knowledge transfer to the industry will be possible. Her most common platform for knowledge transfer to the industry is via popular (plain language) articles in *Winetech Technical* in *WineLand* magazine.

According to participant 8, the NRF is not so concerned with knowledge transfer to industry but is more concerned with general social responsibility and social impact. Other than that, they seem to focus more on academic outputs. This is echoed by participant 2 in her comment:

"For the NRF, there is a soft expectation sort of optional or not included in applications where you can describe community engagement activities or public communication engagements, which you put in your application, but it's rarely enforced. It is more sort of a suggestion of how you think you will be communicating research as the opportunity arises for you to speak wherever it is. It is not a hard and fast rule that they enforce, but it is always recommended by the NRF. Never enforced, as I say."

Participant 3 felt that the pressure from Winetech to communicate research results beyond the academic realm also includes scrutinising whether research objectives were achieved and that they were achieved within the time frame set out in the original project application. The "pressure to perform" was higher with industry funding than governmental funding. His experience is that the NRF is not that strict in monitoring whether initial set objectives have been achieved, giving an academic more "freedom."

Participant 4 confirms this experience with the NRF. In his case, he does not necessarily perceive it as a positive since he finds interaction with a funder during a research project valuable. After he submits a progress report to his main industry funder (a commercial company), there is always a discussion of all the results and input is provided by the commercial company's highly qualified R&D people. The complete opposite happens with the NRF.

"If you are funded from the NRF, okay, this is the other extreme, where there's nothing. You provide a report and say that it's filed. I always think that I can speak about the weather forecast, and no one would blink because I think it's just for filing and no editing purposes. I seriously doubt that anyone reads these reports. I might be wrong? But we never get feedback anyway. So that's the other extreme. So, it's difficult to get funding, but once you get it, it's approved for three years, and that's it. Then you provide a report every year, and you never get any feedback, and that's till the end."

"It's a completely absurd system."

"I actually like the input from the industry because some people provide a different perspective as well. And it kind of keeps one grounded too, as well to a certain extent."

"I am not a winemaker; I don't analyse grape juices every year or wine. So sometimes it is good to hear what the problems are because it leads to further research." Participant 4

Regarding scientific publication, none of the funders seems to be prescriptive regarding whether they should publish open access or not or what the journal's impact factor must be. Interestingly, participants 4 and 11 mentioned the freedom of choice from Lallemand to publish in whichever journal they envision the publication will have the highest impact. The researchers are not required to publish in wine-related journals only but can publish in "highly fundamental" journals such as *Environmental Microbiology, FEMS Yeast Research, Frontiers Microbiology* and *Food Microbiology*.

According to participants 4 and 11, commercial companies commission research with academic institutions for two reasons. Firstly, companies cannot do all the research they want in-house because of cost (maybe), so they outsource to universities. Secondly, there seems to be pressure from the industry to independently verify the quality of the products from the commercial company they are using.

"They [Lallemand] see that as a guarantee that this is robust from a scientific point of view. Therefore, it can then be used. They can even use it to market the research." Participant 4

Finally, the Royal Society seems to require scientific communication (publications) and only encourages science communication (interaction with the public) but doesn't enforce it.

5.3.4 INDIVIDUAL CHARACTERISTICS

Participants were asked various questions related to their industry engagement actions. Firstly, they were asked about their personal preferences regarding the research type they do. Secondly, they were asked with whom they engage in industry and how. This question was asked to determine the knowledge flow channels and audiences. Lastly, they were asked about their motivations and constraints for engaging in knowledge-related interactions with the industry.

5.3.4.1 Researchers' personal preferences for knowledge production

Participants were asked what their personal preferences were regarding fundamental and applied research and if they thought it was possible to strike a balance between excellence and relevance.

Some researchers described their research as applied and that it is what they prefer doing. Participants 3 and 8, for instance, preferred applied research, as demonstrated by their quotes:

"At this stage, I enjoy applied research more. I don't think I am an absolute fundamental researcher, typical…how can I put it…a scientific researcher in the traditional sense. I like it that my research is in tune with the industry."

"My focus will preferably always be applied research. If I have a choice." Participant 3 (translated from Afrikaans)

"For me to do academic research that is so fundamental that nobody understands it, on something like sensory [analysis], makes no sense in my philosophy."

"I am pragmatic. For me, there must be a podium for someone else other than only in my field." Participant 8

Other researchers described their projects as being applied but still containing fundamental components.

"I think I am kind of lucky in that my research is very applied. I am not a chemist or a biotechnologist, or anything like that. All my research has always been quite applied research. I think that I fit very well into that strategy that they [Winetech] have now. I think I keep some, you know, academia standards research, like more fundamental research. I also have some fundamental research as part of my studies, but there is a very clear application goal at the end of the day. So, I think my research fits and qualifies well with what Winetech requires." Participant 1

According to participant 7, her research is not necessarily directly applied, but the researchers doing applied research rely on her research skills and expertise. She considers it unique qualifications essential to have in the DVO environment.

"Very few can do the part that I can do."

"But I'd rather stick to my job and not try to do someone else's job that they are better qualified to do anyway." Participant 7

Only two of the 11 researchers pointed out that they prefer to do basic research. One researcher felt the pressures imposed by industry funders are not always logically connected to what a researcher can achieve and that there is a misalignment between researchers and industry in terms of expectations. He is also worried about the decline in basic research funding, which could lead to a decrease in basic research.

"I would prefer if I could get more funding to do basic research. That satisfies my inclinations as a researcher. I see the importance of basic research driving applied research. In the absence of basic research, you don't necessarily have the foundation upon which to actually build applied research."

"I think we have a problem in this country that our biggest funding situation with our public funding institutions, that our basic research funding suffered a lot. So, I think that is a big worry." Participant 9

The other researcher prefers basic research for two reasons: 1. The perception that it is more cutting edge with high novelty and personally enjoys it more, 2. the perception that industry research can negatively affect publication output.

"The NRF still allows more broad curiosity-driven fundamental research whereas industry funding is very specific and hard to publish because there is often low novelty research that is required by industry." Participant 2

In conclusion, eight of the 11 participants prefer and enjoy doing applied research that addresses industry problems or questions. Even though they broadly classify their research as "applied", it contains enough novel (curiosity-driven/fundamental) components to publish the results in scientific journals, which is an absolute requirement from SU, according to the participants. One researcher felt her research is indirectly applied since it supports applied research projects. Even though two researchers have received industry funding in the past, they prefer to do basic research.

To the question, if participants thought research projects could contain both fundamental and applied aspects, i.e., being both excellent and relevant, most said yes. They design the projects to meet the industry's research agenda and add components that will satisfy their and the university's academic needs.

"I don't think there is a single project that is purely curiosity-driven and one that would be purely applied. A purely applied project would be something we do for specific industry partners. That's very boring, to be honest, and it's not really research. It's testing. Sometimes it's, I won't say it's boring, I mean, the test itself is boring, but sometimes it reveals interesting things that can lead to further research. But all the other proper research projects, they all have a bit of everything." Participant 4

For participant 7, the excellence component of a project is achieved by the detailed efforts put in to obtain the relevant answers.

"I can complicate things quite a lot to make them academically relevant."

"I start with, for example, what I have to do, in the sense that if I get funding, I have to achieve these things. Then I want to do it to the best of my abilities, which from this point of view will give me excellence from an academic point of view." Participant 7

She finds adding "academic value" to the relevance effortless.

Participant 3 felt it is easy to design a research project with strong excellence and relevance components, but it substantially increases the project's cost. He does not know if industry funders always have the "luxury" of funding such projects. As a result, he occasionally performs research, which is "obvious" to him but not necessarily to the industry, to keep the industry happy. That part of the project is sometimes not even publishable. It usually only forms part of a more significant research project that meets academic standards and can be published.

Participant 9 found balancing excellence and relevance difficult.

"The pressures imposed by the funders in terms of what they want to achieve…they have objectives that are not necessarily logically connected with what you, as a researcher, can do. So, I have found that to be challenging. The relationship between doing a project and then having the goal posts maybe shift. But there's no sort of bridge of understanding between the industry funders and the scientific basis upon which the research can be conducted. So more recently, I have had that experience. It's sad really because the project was going in a positive direction. There was scope. And I think there was sort of a complete misalignment between the research scientists and the industry in terms of understanding what could be achieved." Participant 9

Finally, participant 2 provided an interesting outlook on excellence and relevance. According to her, "excellence and relevance work well together over longer timelines." She describes it as "anticipatory research" that will solve problems five, eight, or ten years from now.

"If you shorten the time frame to a two-year period because if you think of it as a graph, the excellence comes down, the shorter the deliverable time frame is because you're working too much in the known space. Already the person's exploring the unknown space scientifically if you're looking at a longer trajectory of when your research is going to be practically relevant if that makes sense?"

Both participants 2 and 9 previously indicated their preference for basic research, probably because of their views and experiences regarding balancing excellence and relevance. Participant 2, however, did note that it is possible to have short time frame projects that can have both excellence and relevance and that "many have been in the past."

5.3.4.2 Industry engagement/knowledge transfer

The academic literature specifically related to this study list numerous types of knowledge transfer activities that can take place between academic researchers and industry practitioners (Jacobson, Butterill & Goering, 2004; Giuliani et al., 2010; Perkmann et al., 2013; Iorio, Labory & Rentocchini, 2017; Rajaeian, Cater-Steel & Lane, 2018). Table 5.2 provides an adapted summary of these listed activities. Commercialisation-related activities are excluded since they are not relevant to this study. Researchers' communication activities involving the public, such as public lectures at schools, museums and media interaction, are also limited as this study focused on a specific public (winemakers) only and the knowledge transfer channels related to them.

Table 5.2: Direct and indirect knowledge transfer activities between academic researchers and industry

Knowledge transfer activity	Description	Oenology-related examples linked to the 11 interviewed researchers
Collaborative (joint) research	Original research that is undertaken by academia and industry together.	None in the true sense of the definition; however, in various projects industry provides information needed for the project.
Contract research	Industry commissioned original research conducted by academia alone	Winetech & Lallemand
Scientific publication	The publication of codified scientific knowledge is predominantly used to communicate with the scientific community. Some scientifically-minded intermediaries and practitioners have access to subscription journals. Everyone has access to Open Access journals.	Paywall: *Journal of Agricultural and Food Chemistry, Australian Journal of Grape and Wine Research* Open access: *South African Journal of Enology and Viticulture, Oeno One*
Scientific conferences and conference proceedings	The oral presentation of scientific results by researchers to predominantly other researchers and scientifically inclined intermediaries and practitioners.	South African Society for Enology and Viticulture conference, Macrowine & Enoforum
Teaching and student supervision	Researchers transfer knowledge to pre- and postgraduate students who graduate and become intermediaries and practitioners in the industry.	B.Sc. Agric in Viticulture and Oenology, Stellenbosch University (SU) Postgraduate degrees in Grape and Wine Sciences, SU
University short courses and workshops	Short courses and workshops organised by the Department of Viticulture and Oenology for industry members.	*Brettanomyces* short course (once-off) Oxygen workshop (once-off)
Consultation	Researchers augment their income by consulting in their private capacity with industry practitioners.	None
Practitioner oriented books[18]	Subject-specific books containing scientific explanations and practical recommendations for practitioners.	Handbook of Enology Principles and Practices of Winemaking Wine Microbiology and Biotechnology
Practitioner magazines	Industry-related magazines, printed and online that contain various types of information related to the industry, including a technical section where	*WineLand* magazine

[18] General winemaking textbooks and not books the participants in this study necessarily contributed to.

	researchers publish plain language science articles.	
Social media	Plain language summaries of research articles, blogs, Facebook, Instagram, LinkedIn, Twitter, etc.	*Winetech Scan* (article summaries) Sauvignon Blanc Association of South Africa (blog) Thewineprof (Facebook)
Industry seminars	Researchers present their latest research results or deliver generalised talks on their specific field of expertise.	Shiraz South Africa technical day Lallemand malolactic fermentation schools Enartis technical seminars
Informal interactive knowledge transfer	This includes ad hoc conversations researchers can have with practitioners: specific problem solving, practitioner study group participation, field days, etc., depending on industry type.	Problems with regards to malolactic fermentation, phenolic analysis and smoke taint. Cape Wine Forum study group Breedekloof winemakers study group Pinotage Association Board Shiraz Association Board Sensory analyses Winetech required industry interaction

5.3.4.3 Knowledge transfer: to whom and how?

Knowledge can be transferred through various channels, and according to Servaes and Malikhao (2005), the nature of the communication through the channels can be two-fold: one-way/unidirectional or interactive/participatory. Alavi and Leidner (1999) and Panahi et al. (2016) argue that unidirectional knowledge transfer channels are important in generalised settings and facilitate explicit knowledge transfer and that interactive knowledge transfer channels allow for the communication of highly contextualised knowledge, which can include tacit knowledge. The results obtained in the researcher interviews regarding knowledge transfer and industry engagement are presented here as these two types of knowledge transfer.

Unidirectional knowledge transfer channels in this study include factual written material published in print and online and face-to-face presentations at conferences, seminars and workshops. Interactive knowledge transfer channels include any setting, whether face-to-face or social media, where knowledge exchange occurs between researcher and practitioner and can consist of factual and practical information. The practical information can also include tacit knowledge.

In terms of unidirectional knowledge transfer, all the participants indicated that they have written (or co-authored with their students) plain language popular articles about their research for winemakers, primarily published in *Winetech Technical* in *WineLand* magazine. A search on the WineLand Media website confirmed this fact. Other unidirectional knowledge transfer activities mentioned by participants and aimed at winemakers and winemaking intermediaries include presenting at the South African Society for Enology and Viticulture (SASEV) conference and at industry seminars (including die cultivar associations' technical days) as well as presenting at Stellenbosch University and industry workshops.

Workshops, however, can be seen as having both formal knowledge transfer (unidirectional) and interactive knowledge exchange components, depending on the level of engagement with the audience. In the case of winemaking-related workshops, wine tastings often form part of the workshops, leading to a high level of engagement, as all usually discuss the tasting results.

Interactive knowledge exchange activities mentioned by the participants include:

- providing feedback to winemakers if they provided grapes, juice or wine samples for a research project (face-to-face[19], phone or email),
- discussions with winemakers as requested by Winetech to prove industry relevance in new project applications (face-to-face or email),
- discussions with Winetech committee members, which include winemakers, on the progress of funded research projects (face-to-face)
- discussions with other funders (face-to-face, phone or email), primarily commercial companies' R&D personnel,
- presentations and discussions with winemaker study groups, e.g., The Cape Wine Forum (face-to-face),
- "collaborative" research where industry's input and help are required with research projects (face-to-face, phone and email),
- Ad hoc conversations with winemakers regarding a specific request or problem (face-to-face, phone or email).

[19] Researcher interview results were obtained before the onset of the COVID-19 pandemic. Since the pandemic, many in-person face-to-face meetings have been replaced by online meetings using platforms such as Google Meet, Microsoft Teams and Zoom.

Only one participant mentioned that he uses Facebook as a knowledge transfer and exchange platform with winemakers. The Facebook page is also open to the public. Three participants said they don't see themselves involved in social media platforms. Time constraints, lack of know-how and lack of desire to use social media were given as reasons for not engaging in social media platforms, as demonstrated by this quote from participant 6.

"Who's got time to sit and update Facebook pages when you've got papers and conferences and Zoom calls and marking coming out of your ears? I wish there were somebody in our department who could take ownership. I mean {the name of another researcher in the DVO} has put me out there on her…she got something. Something that she twitters or tweets or something. She published a little piece on me, and apparently, it got liked and forwarded or something. To be honest, I really don't understand how these things work."

"I just don't have time at this point in my life to understand how these things work." Participant 6

One participant expressed fear as a reason for not using social media.

"I need to up my social media presence, which frightens me to death. I have a Facebook and Twitter account, but I have never used it in a constructive way." Participant 5

Finally, one participant mentioned that she currently has no industry engagement since her funder does not require her to interact or do any formal knowledge transfer to anyone other than academia. According to her, her funder encourages it, but it is not enforced.

5.3.4.4 Personal motivations to engage with industry

According to Iorio et al. (2017), researchers' willingness to engage with industry in knowledge transfer (KT) activities can be influenced by different intrinsic and extrinsic motivations. Intrinsic motivation refers to internal factors such as self-esteem, satisfaction, competence and pro-social behaviour. Pro-social behaviour refers to the motivation to create and disseminate new knowledge to benefit the territory and broader society. This is also referred to as a desire to fulfil the university's third mission (Rajaeian, Cater-Steel & Lane, 2018). Extrinsic motivations refer to external factors like rewards in terms of money, promotion, reputation and praise (Iorio, Labory & Rentocchini, 2017).

All the participants acknowledged the importance of industry engagement and knowledge transfer. Some indicated that it gives them personal satisfaction to listen to and help the industry. Some participants also mentioned that talking to winemakers makes them aware of the industry's problems and allows them to design or shape their research projects to address them. Two participants found industry engagement challenging, and one person despises it. The following quotes demonstrate how participants reacted to the question: What motivates you to engage with industry?

Participant 1 indicated that he enjoys speaking to winemakers. He finds the conversations interesting and very informative. They make him aware of the challenges they face and give him ideas on how to design research projects to address these challenges. He also believes his role as a university researcher is to help the industry. He does not believe in only researching to publish a paper. There must be value in it for the industry.

"I really enjoy listening to them and the way they speak and their approach and the problems they have. So that is good. I enjoy that. I like that."

"It is really about understanding what they need. I think our role is to translate their needs into a research project that can solve their problem. Something that I enjoy a lot is the technology they use or the way they understand certain things. And then you need to translate that into a variable, and that is a nice game. I enjoy that. And that is a good way of also being aware of the problems they face. They say you can be very away from reality here [university] when reading only publications. You can come up with a research project that somebody will publish, but is that something that industry needs? So, I think that is the information you extract from winemakers by listening to them. Participant 1

Participant 3 also indicated deriving enjoyment from speaking with winemakers but stated that it does require some skill to be able to communicate on their level. He also mentioned that his main funder, Winetech, expects communication with the industry.

"I enjoy speaking to winemakers, but I think it is a skill. I enjoy it, and I think it is important. Well, the main funder expects it to some extent." Participant 3 (translated from Afrikaans)

Participant 5 expressed the desire to engage with industry more frequently and constructively. He indicated that researchers don't always know the right people in the industry to interact with and who can represent the industry. He felt an intermediary, such as Winetech, could potentially assist with bringing them in contact with the right individuals.

"We want to have a serious discussion, you know. We want to really look at what are the problems people face. What are your primary concerns? What do you think we as scientists can actually contribute?" Participant 5

Participant 8 felt strongly that she could not work without the input she received from the industry. It is integral to her research outputs and outcomes and allows her to enjoy her role as a researcher.

"To package it [a project] so that it is valuable to industry, that to me is the most enjoyable and biggest challenge."

"I really enjoy having contact with industry. The conversations, the things we do together."

"*I cannot work without industry. I sometimes think I am one of the people with the most industry contacts on my phone.* Participant 8 (translated from Afrikaans)

Participant 10 had a specific desire to communicate her research not only to industry practitioners but also to farm labourers.

Participant 11 was very passionate about her industry engagement activities and indicated that it is one of the reasons why she chose working at the university as a career path.

"I don't need any motivation. I am at the university because it is an absolute pleasure to help people and broaden their opinions, expertise and knowledge. That is why I am crazy about lecturing; it energises me. And that energy from solving problems in industry…I like it. It is my absolute passion to make the subject knowledge accessible for someone else." Participant 11 (translated from Afrikaans)

Only one participant indicated that she does not like to engage with industry and will only do it if required. Despite her dislike of engagement activities, she still views them as very important and something that should be done by someone else.

I don't like engaging with people in general. Why must I do something voluntarily if it was not a requirement? Whether it is a speaking engagement or a social engagement, I have an equal aversion to both. Only if it is a necessity. Participant 2

It seems that participant 2 eschews engagement with people in general and not necessarily just winemakers. On the occasions, however, that she did interact because a funder requested it, she found the experience to be positive.

"The ones [winemakers] that did respond were very helpful."

"And the side conversations were interesting as well, hearing about what other problems they were experiencing in general even though they were outside my field or my ability to research." Participant 2

Participant 7 specifically referred to what motivates her to write plain language popular articles for the industry.

"I quite enjoy that. It makes me think about my work in different terms. I always have this idea that I need to explain to somebody who is a smart person but does not have the same background as I do. So, you don't dumb down; you just explain it in plainer terms." Participant 7

Some participants indicated that they engaged a lot and others felt they probably engaged too little. Two participants indicated that they would like to engage more. Table 5.3 summarises the main motivations of oenology researchers to engage with industry in knowledge-related interactions.

Table 5.3. The four main motivations for industry engagements mentioned by the participants

Motivation	Type
Personal satisfaction	Intrinsic
Pro-social / third mission	Intrinsic
To obtain information for the research	Extrinsic
Funding pre-requisite (monetary)	Extrinsic

5.3.5 CONSTRAINTS TO ENGAGING WITH INDUSTRY

Participants were asked what constrains them from engaging in knowledge transfer (KT) activities to industry more frequently than they currently do. The participants mentioned the following factors:

Individual factors and perceptions

- Lack of know-how on how to write popular articles and do presentations to an industry audience
- Lack of natural (journalistic) talent to be a good communicator
- The perception that you must be someone of prominence to speak to industry and that industry prefers speaking to certain researchers
- Industry lacking interest in research or lacking interest in speaking to researchers
- Experiencing industry to be conservative
- Uncertainty of what industry wants

- Lack of time to engage in non-academic activities due to pressure from industry research funders to deliver as promised and on time (participants mentioned that they experience less pressure to perform from the main public funder)
- Not a researcher for long enough to have built up trusting relationships with industry (young researchers)
- Lack of self-confidence doing knowledge transfer to a non-academic audience (ties in with lack of know-how)
- Not knowing what the industry audience's level of existing knowledge on the topic is
- Not knowing who to speak with in the industry
- Lack of desire to do KT

Organisational factors

- Lack of time to engage in non-academic activities due to institutional (Stellenbosch University) expectations (publications, admin)
- Some post-graduate students require more intense supervision than others, infringing on time that could have been spent on KT activities (ties in with lack of time)
- Lack of institutional funding for KT activities
- Lack of institutional recognition for KT activities
- Lack of institutional training on KT to non-academic audiences

5.3.6 BENEFITS AND DRAWBACKS OF INDUSTRY ENGAGEMENT AND KNOWLEDGE TRANSFER

Participants were asked if engaging in industry-funded research, and knowledge transfer activities have been to their academic advantage or disadvantage and to give examples of what has been positively or negatively influenced.

The general sentiment in the group was that industry engagement positively influenced their academic careers. Engaging with the industry to discover their challenges and formulating a research project that addresses them can lead to funding approval. Funding leads to publications that satisfy the university's expectations. Some of these industry-funded projects have had excellent academic novelty, and participants 8 and 10 commented that industry-focused research and interaction allowed them to publish in "good" scientific journals.

"With this industry-focused research, we have had a publication in Nature [Scientific Reports]. I cannot ask for more." Participant 8 (translated from Afrikaans)

"My interaction with wine farms themselves, I think, has always been a positive interaction, and all the input that they have made and the information that they have shared, and they have always been willing to share the information, have been used in our publications, with their permission. It has allowed us to have good quality publications if I can put it that way." Participant 10

Participant 1, however, mentioned that he has occasionally struggled to publish applied research because of his practical or simplified approach in his publications. The reviewers would comment that the article is interesting but reads more like a popular article or book chapter. Reviewers have also occasionally wanted more scientific data and a more scientific approach. He concludes that publishing applied research "can sometimes be contradictory to publishing in a high impact journal."

Participant 10 mentioned that even though research funded by industry has not influenced her publication output negatively, it has, on occasion, influenced her research agenda. Even though she adapted the projects to the funder's requirements, it was not always her preferred route of action.

"If there is anything negative, it is more from the funding aspect of it. Because obviously, if you are not getting funding, then you are re-thinking what you are doing, and it's not a bad thing. It just pushes you to think in a different way and adapt and move on. But no, I don't think it has impacted negatively in terms of the quality of work we do or the quality of output. Or the number of publications that we have been able to generate. I don't think so. I would like for it to be different in some cases. But we haven't been able to succeed." Participant 10

According to Participant 3, applied research is not always published in high-impact journals like fundamental research and could potentially influence one's career progression at the university. He also felt that he was spending less time doing fundamental research, which according to him, is more valued within the university system. He sees this as a shortcoming of the university and that the evaluation system should look beyond the journal's impact factor at the broader impact of the research outside academia. Even though he has concerns about the potential adverse effects of industry engagement, he still believes that the advantages outweigh the disadvantages.

"Winemakers are good observers. They cannot always explain things, but they are good observers to say something happened; they don't know why it happened, but they saw it happening. They sometimes see things that can have academic novelty." Participant 3

The industry as a source of research ideas was echoed by participants 7 and 9.

Participant 7 also felt that because of all the plain language popular articles she has written for industry, she has become better at explaining her research, even in scientific publications.

"I think writing popular articles made me better at storytelling, that golden thread that we look for in different scientific articles and research in general."

"Letting me loose out of the lab has definitely benefitted me in many ways. I mean, even from the point of view of being able to grasp opportunities in somebody's question." Research or collaboration opportunities. So, it benefitted me professionally, not only through the research but also through…almost like a personal, professional aspect." Participant 7

However, participant 7 wondered if one of her industry commissioned projects could not have had a better outcome if it was performed by another researcher with more applied knowledge, unlike her, who usually focuses more on fundamental research. She explained that the study made her "uncomfortable" because she "didn't know much about it." The fact that the research agenda was not her field of expertise might have negatively influenced the industrial outcome, even though it was academically successful.

Table 5.4 summarises the participants' benefits and drawbacks of industry engagement.

Table 5.4 Summary of the benefits and drawbacks of industry engagement and knowledge transfer mentioned by the participants

Benefits of industry engagement	**Drawbacks of industry engagement**
Funding for research projects	Can affect the quality of the journal
A source of research ideas	Can affect the research agenda in a manner that was not the preferred mode of action for the researcher
A source of practical information that can sometimes be included in publications	A researcher not skilled at performing the specific requirements of the industry due to a lack of practical knowledge
A source of information on "how not to do things"	
A source of research raw materials – grapes, juice and wine	
Improvement of their science communication skills	
Personal enjoyment	

5.4 RESULTS SUMMARY

Most of the oenology researchers interviewed saw their research as predominantly “applied.” They had no objections to doing applied research since they view themselves as inherently “pragmatic” or because they started their academic careers in an applied field and are continuing that path. Even though the projects are designed to meet the required applied needs of the industry funders, the participants indicated that most of the time, they can strike a balance between excellence and relevance and, therefore, still meet the university’s requirements in terms of academic outputs. The minority of the participants indicated they prefer fundamental research because they either find it more exciting or view it as research that will benefit society in the long term. All the participants mentioned that their academic outputs carry the most weight in their performance evaluations.

Most of the participants like interacting with industry. They feel the industry gives them ideas for research and information for their projects that benefit their academic outcomes regarding publications and citations. In addition to the benefits for their academic careers, many indicated enjoyment associated with interacting with industry members. Some also saw it as their duty to transfer knowledge to the industry. One can therefore conclude that most of the participants are intrinsically motivated to engage with industry. Those who interact with industry to obtain funding for their research can be viewed as extrinsically motivated. Still, since most of them also indicated they enjoy interacting with industry, it can be considered as coupled with intrinsic motivation.

The participants willingly interact with industry and do KT to the industry despite the constraints they experience in the university environment. The most significant limitation is finding the time since their time is filled with trying to fulfil the university’s output expectations. Other restrictions greatly influencing their KT activities include lack of KT training, lack of dedicated funding to execute KT activities, not knowing who to interact with, lack of KT skills and lack of confidence.

Some participants indicated that if they received only public funding, which generally requires less interaction with practitioners, they probably would stop interacting with industry, even though they enjoy it. They will shift their focus to more fundamental aspects of research projects.

Whilst they still have industry funding and the industry expects that they should engage, they wish for the university to acknowledge their engagement and KT actions one way or another. The social impact policy of the university needs clarification, and for those interested in having a significant social impact footprint, it should count as a promotional criterium.

Participants also feel that industry engagement and knowledge transfer do not come naturally to everyone, and that should be respected. Students and academics should not be forced to go for training if it is not their desire to do so.

Finally, three participants mentioned that communication and appreciation work both ways. The industry should also be willing to communicate and have an active and open knowledge exchange. Two participants felt their expertise was underappreciated and underutilised over the past few years by the SA wine industry. The industry would “fly in people from overseas” rather than realise that they have the expertise on their doorstep. At the same time, they are regularly invited as experts by international wine industries and asked to present at their technical forums. A third participant indicated that he sometimes finds communicating with the industry strenuous. He is unsure why but speculates that it is due to a lack of knowledge, unwillingness to see the other perspective, or an attitude problem.

Chapter 6 presents how the industry perceives the DVO researchers and their knowledge-related interactions with them.

CHAPTER 6: THE INFORMATION-SEEKING BEHAVIOURS OF SOUTH AFRICAN WINEMAKERS AND INTERMEDIARIES

6.1 INTRODUCTION

Over the past few decades, the global wine industry has experienced a drastic move from a traditionally low-tech and low-knowledge-intensive industry to a knowledge-intensive, scientific and innovative industry (Lenzi, 2013). Consumer taste demands led to a shift from bulk to more premium wines, increasing the competition amongst countries in the global market and the resulting need to be innovative to remain profitable. This led to wine industries now employing specialised knowledge workers with university degrees, who are expected to regularly introduce new science-based practices in the vineyard and the cellar, thereby radically enhancing the winemaking process. Such a knowledge-intensive industry requires an effective knowledge transfer system for practitioners to be aware of innovations that they can potentially use. There are, however, various factors that can influence knowledge uptake by practitioners. These factors include practitioners' individual characteristics, the knowledge source's characteristics, the knowledge itself, knowledge transfer channels and the role of intermediaries (reviewed in Chapter 3).

In the past, agricultural knowledge systems entailed academic researchers producing new knowledge and extension officers packaging it and communicating it in a top-down approach to practitioners (Lubell, Niles & Hoffman, 2014). Modern-day agricultural knowledge systems feature a much greater network of actors promoting various learning pathways, i.e., technical, social, and experiential learning (Lubell, Niles & Hoffman, 2014).

This chapter presents the results of an exploratory study, with individual winemakers and winemaking intermediaries of the South African (SA) wine industry as the units of analysis. The empirical evidence was obtained from a web survey amongst winemakers and semi-structured interviews with winemakers and intermediaries. The data builds on previous studies and surveys related to knowledge transfer and utilisation in different wine industries in the world (Boshoff, 2012; Dippenaar, 2017; Giuliani et al., 2010; Given et al., 2016; Hill et al., 2015; Lenzi, 2013; Lubell et al., 2014; Szymanski, 2016; Szymanski & Davis, 2015).

The quantitative web survey part of the empirical study investigated the information-seeking behaviours of SA winemakers. Thirty-six sources of winemaking information were identified. These included sources of validated scientific research results. The questionnaire explored various aspects such as time spent on obtaining new winemaking-related knowledge, resource preferences, trust in the knowledge sources, and, importantly, winemakers' interest in scientific research and interaction with researchers from the Department of Viticulture and Oenology (DVO) at Stellenbosch University (SU).

The qualitative semi-structured interviews with winemakers explored the reasons for answers provided in the web survey. In addition, semi-structured interviews with intermediaries were conducted as they emerged as important boundary spanners in the SA wine industry's knowledge transfer system.

The results are presented in four sections. Section 6.2 reports the demographics of the winemakers that took part in the web survey. Section 6.3 places the information-seeking behaviours of winemakers in context by focusing on the time spent on self-directed learning, frequency of knowledge source used, the level of trust placed in the accuracy of wine science of the knowledge sources, winemakers' beliefs, behaviours, and interests with regards to information seeking, and their relationship with oenology researchers from the DVO of SU. Sections 6.4 and 6.5 present the results of the semi-structured interviews with purposefully selected winemakers and intermediaries.

Chapter 6 answers the second part of the question: "What factors and conditions characterise the institutional landscape and information-seeking behaviours of South African winemakers?" The first part of the question (the institutional landscape) was addressed in Chapter 3 of the literature study through a documentary analysis of structures and initiatives in the South African wine industry.

6.2 DEMOGRAPHICS OF WINEMAKERS SURVEYED

The web survey delivered 124 respondents in total, but since none of the questions were compulsory, questions had different response rates. Of the 111 respondents who specified their gender, 71% were male, and 29% were female. The age groups of respondents are depicted in Table 6.1. The largest percentage of respondents (47%) were in the age group 30 – 39 years old.

Figure 6.1 demonstrates the job titles of respondents who completed the questionnaire, with the biggest group being senior or head winemakers (36%), followed by winemakers (24%). The titles "head winemaker" or "senior winemaker" only exist at cellars with more than one winemaker. When a cellar has only one winemaker, the title is "winemaker". Six respondents classified their titles as "other." They were listed as: harvest intern, laboratory manager and head of research and development (R&D), owner/winemaker, winemaker and CEO, winemaker and viticulturist, and winemaker and African sales manager. It is common for winemakers at small wineries to have dual roles, which is most likely the case with some job descriptions mentioned.

Table 6.1: Age of winemakers at time of completion of the survey (N=111)

Age group	Percentage
20 - 29	17%
30 - 39	47%
40 - 49	25%
50 - 59	9%
60 - 69	2%
Total	100%

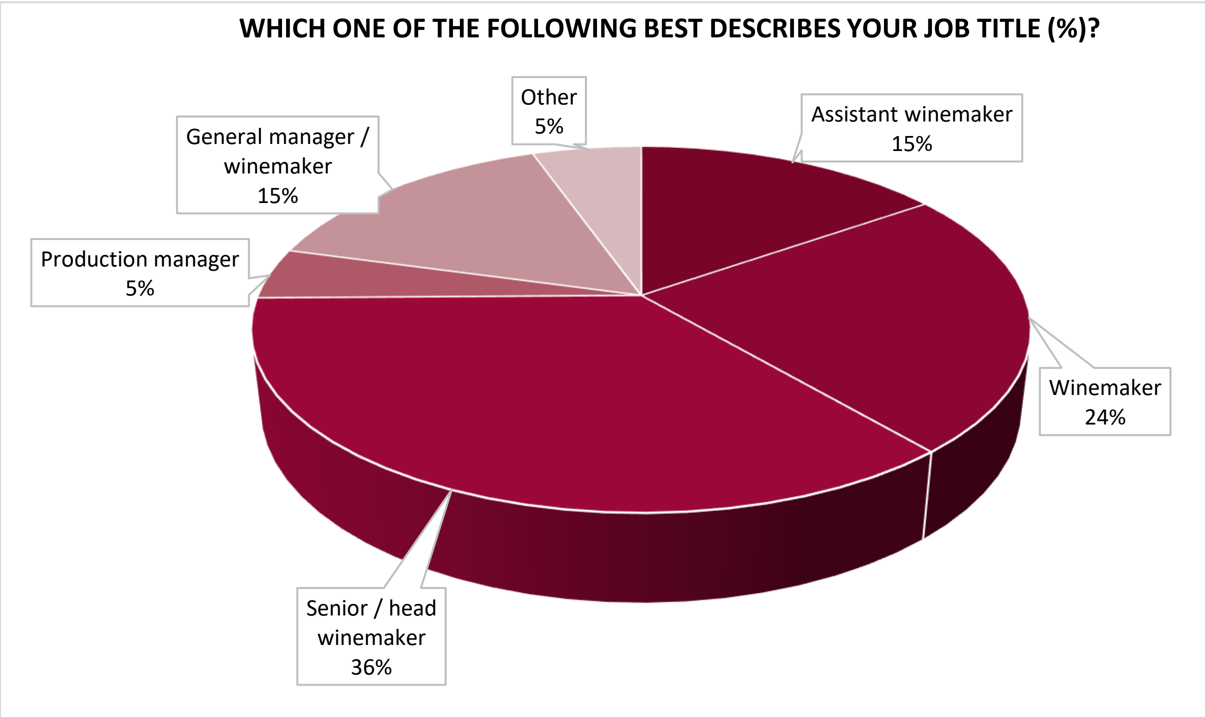

Figure 6.1: Distribution of winemakers by job title (N=111)

The respondents were mainly from estate wineries, production cellars, and private cellars (34%, 34% and 27%) (Figure 6.2). The "other" winery types mentioned (4%) include responses such as "estate winery and private cellar", "independent wine company, small brand – do not own cellar or vineyards", and "virtual winery".

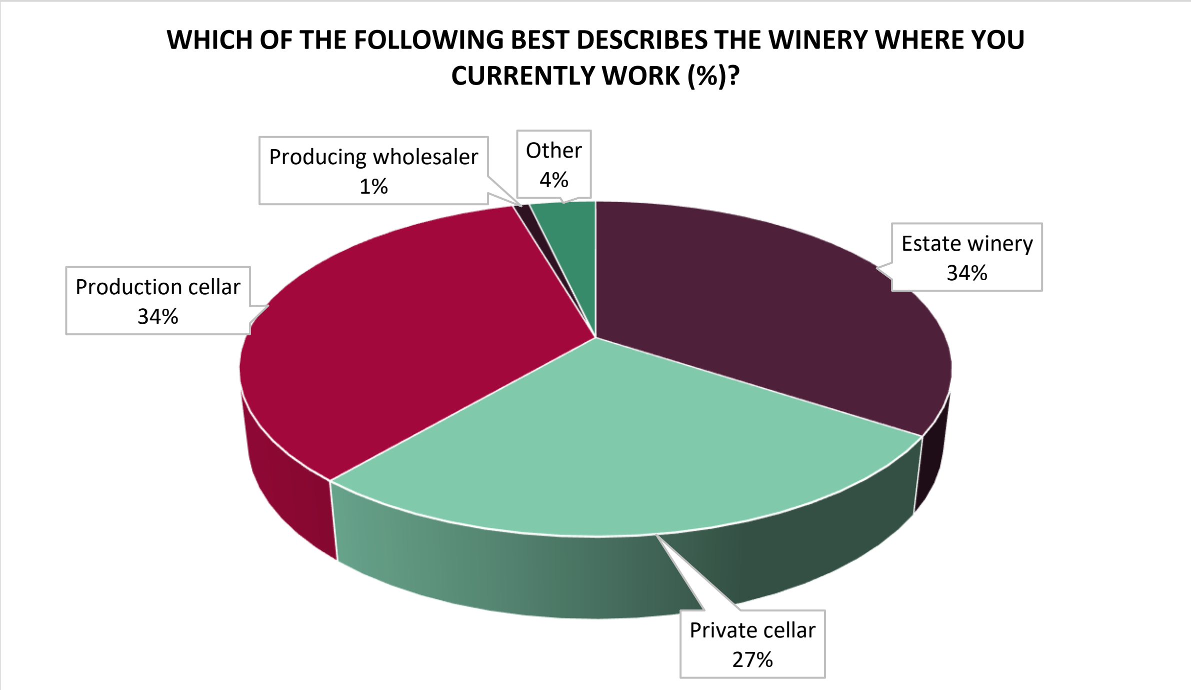

Figure 6.2: Distribution of winemakers by cellar type (N=111)

Table 6.2 demonstrates the areas where the winemakers are from at the time of the interviews. Most respondents were from the Stellenbosch and Breedekloof areas (29% and 15%). The high percentage of respondents from Stellenbosch is due to the large number of winemakers working in predominantly estate wineries in this area. Four respondents listed their area as "other." These areas include Cape Town, Rawsonville, Sondagskloof and VoorPaardeberg.

Table 6.2: Distribution of winemakers by area (N=111)

	Count	**Percentage**
Breedekloof	17	15.3%
Constantia	6	5.4%
Darling	1	0.9%
Durbanville	3	2.7%
Elgin	4	3.6%
Franschhoek	9	8.1%
Northern Cape	2	1.8%
Olifants River	4	3.6%
Overberg	1	0.9%
Paarl	10	9.0%
Robertson	8	7.2%
Stellenbosch	32	28.8%
Swartland	3	2.7%
Tulbagh	1	0.9%
Walker Bay	3	2.7%
Wellington	2	1.8%
Worcester	1	0.9%
Other	4	3.6%
Total	111	100%

The last demographic variable investigated was the highest oenology-related qualification held by the respondents. Respondents could choose from a list of oenology-related qualifications recognised by the South African Qualifications Authority (SAQA)[20] and options to indicate an international qualification, the Stellenbosch University *Garagiste* winemaking short course, or no oenology-related qualifications. Results are presented in Table 6.3. There were no results for PhD in Oenology and Wine Biotechnology and the *Garagiste* winemaking short course; therefore, they don't appear in the table.

[20] https://www.saqa.org.za/

The qualification held by the largest share of respondents (51%) is a B.Sc. Agric in Viticulture and Oenology from Stellenbosch University.

Table 6.3: Highest oenology-related qualification of winemakers (N = 110)

	Count	Percentage
SKOP (Wine Training South Africa)	2	1.8%
National Diploma in Viticulture and Oenology (CPUT)	2	1.8%
Diploma in Cellar Technology (Elsenburg Agricultural Training Institute)	16	14.5%
B. Agric in Cellar Technology (Elsenburg Agricultural Training Institute)	13	11.8%
B. Agric in Cellar Management (Elsenburg Agricultural Training Institute)	1	0.9%
B.Sc. Agric Viticulture and Oenology (Stellenbosch University)	56	50.9%
M.Sc. Agric Oenology (Stellenbosch University)	5	4.5%
Hons. B. Sc Wine Biotechnology (Stellenbosch University)	1	0.9%
M.Sc. Wine Biotechnology (Stellenbosch University)	1	0.9%
International oenology-related qualification	3	2.7%
No official oenology-related qualification	10	9.1%
Total	110	100%

Winemakers were also allowed to indicate if they held any other related or non-related winemaking qualifications not listed on the table (other university degrees, short courses, certificates, diplomas, etc.), and the following extensive list of qualifications was reported:

- University of Cape Town (UCT) Internet Marketing Course; Agric Diploma; B. Agric Cellar Management and Table Grapes; B.Sc. Microbiology; Genetics and Marketing; Bachelor of Arts; Cape Wine Academy (CWA) Diploma 2; Bachelor of Economics; B. Com, Hons. B.Sc. Agric Viticulture and Oenology; Cape Wine Academy Certificate; Certificate in the Business of Wine (UCT); Cape Wine Master; Stellenbosch University (SU) Business School Diploma in Wine Management; Cape Wine Academy Tasting; Diploma in Agriculture Management; Diploma in Viticultural Extension (Elsenburg); Diploma in Viticulture (Elsenburg); Financial - UCT Business School; Foundations of Business Management; HACCP; Honours in Park and Recreation Management; Hons. B.Sc. in Viticulture; Louis Group Business School; Management Development Programme (SU); Marketing Diploma; Master of Wine (United Kingdom); MDP (SU); M.Sc. Agric Viticulture (SU); Postgraduate Diploma in Wine Business Management; and WSET Level 3.

Take note that the above list does not necessarily reflect the correct official names of the qualifications as it is self-reported by the respondents.

In the current web survey conducted in 2019, 57% of winemakers held SU oenology-related pre-and postgraduate degrees. In the previous web survey conducted by Boshoff (2012) in 2010 amongst SA winemakers, only 36% had degrees from SU, and 37% had qualifications from Elsenburg Agricultural Training Institute. It was, therefore, useful to do a crosstabulation between winemaker age and location of qualification (SU and Elsenburg) to determine if it was a trend for aspirational winemakers to choose Stellenbosch University instead of Elsenburg Agricultural Training Institute for their formal qualifications. The results are presented in Table 6.4. In the current study, the younger winemakers are more likely to have an SU qualification, and the older winemakers are more likely to have an Elsenburg qualification.

Stellenbosch University students have active academic researchers as lecturers, and Elsenburg students don’t, which may or may not influence their relationship with academic research and their information-seeking behaviour. The overall oenology-related qualifications of respondents from the two main oenology educational institutes of South Africa decreased with increasing age.

Table 6.4: Crosstabulation between age and Stellenbosch University and Elsenburg Agricultural Training Institute qualifications (N = 110)

Age group	**Percentage of the age group who trained at**		**Percentage of the age group who trained at any of the two**
	Stellenbosch University	**Elsenburg Agricultural Training Institute**	
20 – 29 (n = 19)	79%	16%	95%
30 – 39 (n = 51)	65%	26%	91%
40 – 49 (n = 28)	43%	32%	75%
50 – 59 (n = 10)	30%	40%	70%
60 – 69 (n = 2)	0%	50%	50%

In summary, the winemaker respondents in this study are predominantly male (71%), and most fall within the 30 – 39 (47%) age group. Most respondents are senior or head winemakers at wineries with more than one winemaker (36%) or winemakers in the case of wineries with only one winemaker (23%). More than half of the respondents hold degrees awarded by SU (57%). It is, however, possible that this figure can be higher since three respondents indicated that their highest oenology-related degree is international. It is possible that these degrees can be post-graduate and that their undergraduate degrees are also from the DVO. The respondents were mainly from estate cellars (34%) and production cellars (34%).

An interesting result from the study is the high number and diverse nature of "other" qualifications held by the respondents, either as their only official tertiary qualifications or in addition to their oenology qualifications.

6.3 INFORMATION SEEKING BY WINEMAKERS SURVEYED

A winemaker has various responsibilities, which include the physical act of making wine in the cellar, managing winemaking activities by giving instructions to other winemakers, assistant winemakers and cellar hands, winemaking related administration such as authenticity certification, ISO[21] standards, HACCP[22], ethical trading, etc., spending time in the vineyard to determine optimal ripeness for specific wine styles, and sales and marketing related activities. All these activities can potentially impact their information-seeking behaviours. Compared to other winemaker-related studies (Boshoff, 2012; Hill et al., 2015; Szymanski, 2016), this empirical study is novel in that, in addition to information-seeking behaviours explored in the other studies, it also explored the time spent on self-directed learning compared to other winemaking activities, the percentage of time winemakers seek information about winemaking versus information about their other responsibilities, and the influence of their sales and marketing actions on their winemaking information seeking.

6.3.1 FREQUENCY OF INFORMATION-SEEKING

First, the winemakers surveyed had to indicate what percentage of their working time they spent on various tasks. The results are presented in Table 6.5.

[21] International Organization for Standardization

[22] Hazard Analysis Critical Control Point

Table 6.5: The percentage of time winemakers spend on their different responsibilities (N = 116)

	Minimum % time	**Maximum % time**	**Mean % time**	**Std. Deviation**
Managing winemaking activities (giving instructions)	0	90	27	17.6
Physical winemaking activities in the cellar	0	91	22	14.5
Winemaking-related admin (SAWIS, IPW[23], Wieta[24], ISO, etc.)	0	70	17	14.7
Wine marketing and sales activities (tastings, meeting with buyers, preparing and attending wine shows, etc.)	0	65	14	11.3
Time in the vineyard	0	55	11	10.8
Mentorship/self-learning	0	15	5	3.3
Other	0	35	2	5.5

According to the data, winemakers can spend a significant amount of time on aspects other than physical winemaking and managing winemaking, e.g., admin (17% on average), wine marketing and sales (14% on average) and time in the vineyard (11% on average). The average time spent on self-directed learning (information seeking), or mentoring (information giving) is only 5%. How winemakers spend their time on different responsibilities also informed the selection of winemakers for follow-up interviews.

The next question in the web survey wanted to determine how regularly winemakers consult with external sources of knowledge (rather than relying on their own knowledge) in a typical week. A typical week excludes harvest time when winemakers are extremely busy and potentially have less time to interact with information sources. Results are presented in Figure 6.3.

[23] Integrated Production of Wine – voluntary environmental sustainability scheme of the SA wine industry

[24] Wine & Agricultural Ethical Trade Association – voluntary ethical trade association of the SA wine industry

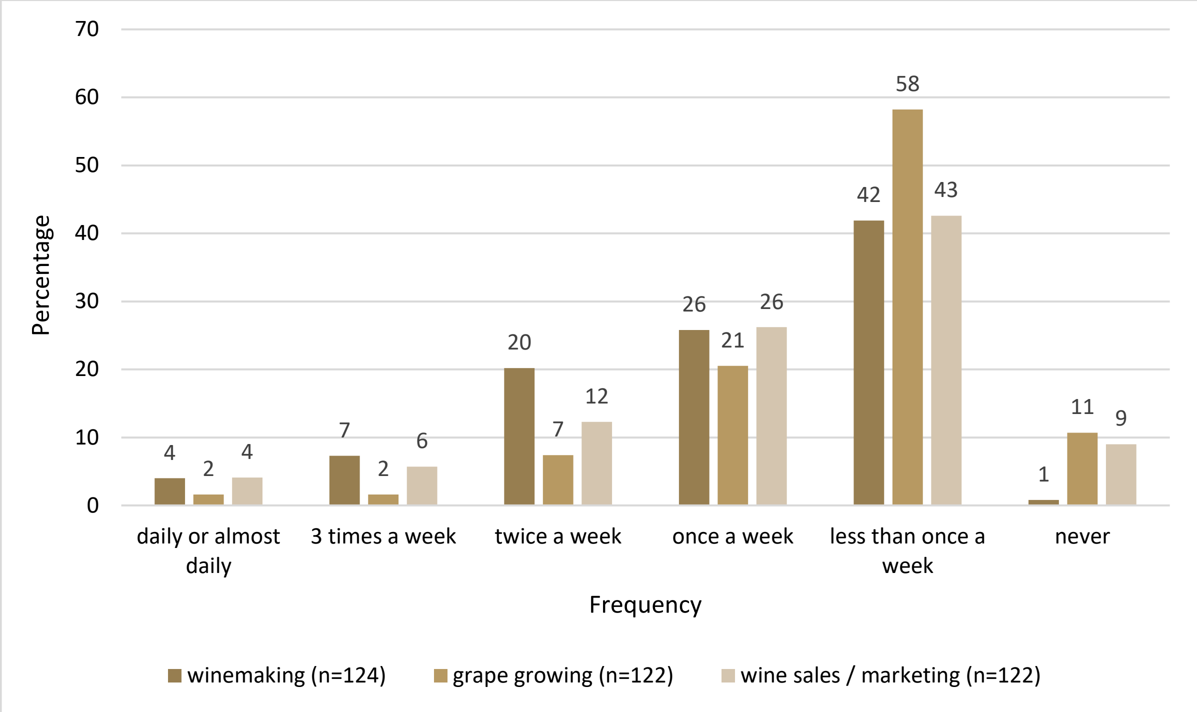

Figure 6.3: How regularly winemakers consult with three types of knowledge in a typical week (percentages reported)

According to the data, the biggest percentages for all three types of information seeking fall in the "less than once a week" category (winemaking = 42%, grape growing = 58%, marketing = 43%). It must be kept in mind that most survey respondents have tertiary qualifications in oenology and viticulture and have significant experience working as winemakers. Therefore, their internal knowledge reservoirs can be sufficient for them not to seek new information weekly. It could also be that they simply don't have the time or are not encouraged by their management to engage with new knowledge.

However, by combining all the responses indicating that a winemaker consulted with the different types of knowledge at least once a week (up to daily or almost daily), a more significant percentage of respondents consulted with oenology (57%) and marketing (48%) related information once or multiple times a week, compared to those engaging less than once a week.

Sixty per cent of winemakers consult sources of grape-growing information less than once a week. Such information also has the highest number of respondents not engaging with it at all (11%). This result can be explained by the fact that most wineries either employ viticulturists or farm managers or use viticultural consultants. In most cases, it is not a primary function of winemakers to also be responsible for grape growing. The never category, selected by small percentages of winemakers, also indicates that it is seldom the case of winemakers not interacting with the three knowledge sources, although to different degrees.

To provide more insights into the results demonstrated in Figure 6.3, winemakers were asked to indicate their level of agreement with statements related to their information-seeking behaviour.

Most winemakers disagreed (40%) with the statement that they divide their time equally between winemaking, grape growing and marketing information-seeking. The percentages of winemakers focusing on viticulture and marketing information are 13% and 16%, respectively (strongly agree + agree), indicating most winemakers focus on winemaking information. Half the winemakers (50% strongly agree + agree) said they only look for winemaking information if they have the time, confirming that time is a factor in their information-seeking behaviour. Almost half of the winemakers (50% strongly agree + agree) indicated that they only look for winemaking information when they have a specific question. Ten per cent of winemakers disagreed with the statement that their managements encouraged them towards self-directed learning, which could also potentially influence information-seeking behaviours negatively. The results in Table 6.6 confirm that time, focus and management support can influence winemakers' information-seeking behaviours, and those factors thus influenced the results presented in Figure 6.3.

Table 6.6: Winemakers’ level of agreement with statements related to their information-seeking behaviours

	Strongly agree	Agree	Indifferent	Disagree	Strongly disagree
Time and focus					
I divide my time equally between gaining new knowledge on winemaking, viticulture and marketing. (n=111)	6.3%	18.9%	27.9%	39.6%	7.2%
I focus more on obtaining viticulture information than winemaking information. (n=110)	2.7%	10.0%	31.8%	41.8%	13.6%
I focus more on obtaining marketing information than winemaking information. (n=110)	3.6%	12.7%	19.1%	42.7%	21.8%
I make the time to gather as much information on winemaking as possible from various resources. (n=110)	8.2%	46.4%	29.1%	13.6%	2.7%
I gather new winemaking information only if I have time. (n=111)	5.4%	44.1%	17.1%	27.9%	5.4%
I only look for information on winemaking when I have a specific question. (n=111)	11.7%	37.8%	12.6%	33.3%	4.5%
Management					
My management encourages me to gain more knowledge through various resources. (n=110)	22.7%	45.5%	21.8%	8.2%	1.8%

6.3.2 FREQUENCY OF KNOWLEDGE SOURCE USAGE

The web survey explored the frequency of use of 36 different sources of winemaking knowledge in the SA wine industry. The knowledge sources were grouped into people, written materials, and events. Knowledge transfer involving people is interactive mainly, whereas knowledge transfer through written materials is predominantly unidirectional. Knowledge transfer at events can be unidirectional and interactive depending on the nature of the event (an academic conference versus informal study groups and field days). Table 6.7 presents the results for people as knowledge sources, based on the question: “On average, how often do you consult with the following people for new or existing winemaking (oenology) information?" The results have been sorted from the most frequent to the least frequent people consulted for winemaking information.

Table 6.7: The frequency with which winemakers consult with different types of people

	Once a week	Once a month	Once every three months	Once every six months	Once a year	Less than once per year	Never
Winemaking colleagues at your cellar (n=110)	58.2%	13.6%	4.5%	1.8%	7.3%	2.7%	11.8%
Winemakers in your area (n=111)	11.7%	41.4%	27.9%	7.2%	4.5%	2.7%	4.5%
Suppliers of oenological products/machinery (n=111)	7.2%	36.0%	28.8%	17.1%	4.5%	3.6%	2.7%
Winemakers in other areas (n=111)	8.1%	25.2%	27.0%	18.9%	9.9%	6.3%	4.5%
Analytical laboratories personnel (n=111)	12.6%	17.1%	14.4%	22.5%	10.8%	11.7%	10.8%
Industry opinion leader/mentor (n=110)	3.6%	13.6%	19.1%	20.9%	20.0%	10.9%	11.8%
Local winemaking consultant(s) (n=111)	6.3%	16.2%	18.0%	10.8%	4.5%	14.4%	29.7%
Winetech employees (n=110)	0.0%	5.5%	6.4%	10.9%	19.1%	18.2%	40%
Stellenbosch University researchers (n=111)	0.0%	0.0%	5.4%	15.3%	18.9%	27.9%	32.4%
International winemaking consultant(s) (n=111)	0.9%	4.5%	7.2%	6.3%	16.2%	21.6%	43.2%
Nietvoorbij researchers (n=111)	0.0%	0.0%	0.9%	2.7%	8.1%	31.5%	56.8%

The results show that participants consulted the most frequently with winemaker colleagues for winemaking information. This was closely followed by consulting with winemakers in their area. For some participants, the information-seeking process stops with speaking to other winemakers. This is according to another question in the web survey where participants had to indicate their level of agreement with statements where 2% of participants strongly agreed and 23% agreed with the statement "talking to another winemaker if I need information is enough." (Table 6.8).

Table 6.8: Winemakers' level of agreement with a statement regarding their information-seeking behaviour

	Strongly agree	Agree	Indifferent	Disagree	Strongly disagree
Talking to another winemaker if I need information is enough. (n=111)	1.8%	23.4%	23.4%	45.0%	6.3%

The third most consulted people according to Table 6.7 are suppliers of oenological products and machinery. This indicates the importance of this group of people in the SA wine industry. Suppliers can be classified as intermediaries as they offer winemakers innovations and the accompanying knowledge. They also provide after-sales practical support and help with problem-solving. They regularly interact with many practitioners and play a significant role in the diffusion of knowledge in a network. Because of this significance, suppliers as intermediaries were also investigated in this empirical study. Results are presented in section 6.5.

Researchers at Stellenbosch University and Nietvoorbij are at the bottom of the table, indicating the least frequent interactions to obtain winemaking information. Winetech employees are also low on the list since Winetech focuses mainly on knowledge transfer through written materials and outsources interactive knowledge transfer activities.

Consultants don't seem to play a prominent role which can be attributed to two main reasons. Firstly, it is a paid service, whereas other sources are free or included in the price of the product (supplier) or service rendered (analytical laboratory). Secondly, winemaking consultants operate individually in the SA wine industry, and there are not many of them. In contrast, most of the viticultural consultants in the industry work for Vinpro (see Chapter 3) and have a united strategic approach to servicing their clients.

The winemakers were also asked to rate the frequency of use of 17 different sources of written winemaking information. Table 6.9 presents the results to the question: "On average, how often do you use the following resources to obtain new or existing winemaking (oenology) information?" The resources listed are all unidirectional except for the social media platforms, which can allow interaction via their comments sections.

Table 6.9: The frequency with which winemakers interact with different types of written materials

	Once a week	**Once a month**	**Once every three months**	**Once every six months**	**Once a year**	**Never**
An Internet search of the topic (e.g., via Google) (n=111)	42.3%	32.4%	12.6%	6.3%	4.5%	1.8%
Supplier/service provider websites (n=111)	17.1%	30.6%	25.2%	10.8%	10.8%	5.4%
Supplier/service provider emails (n=111)	13.5%	27.9%	21.6%	12.6%	12.6%	11.7%
Winetech Technical in printed *WineLand* magazine (n=111)	1.8%	42.3%	20.7%	12.6%	12.6%	9.9%
Oenology textbooks (n=111)	3.6%	20.7%	18.9%	20.7%	23.4%	12.6%
International trade magazines (printed and online) (n=110)	6.4%	20.0%	18.2%	11.8%	20.9%	22.7%
Winetech Scan (emails or website) (n=110)	1.8%	26.4%	16.4%	7.3%	24.5%	23.6%
Winetech Technical online on *WineLand* website (n=111)	1.8%	18.9%	17.1%	19.8%	12.6%	29.7%
Articles in scientific journals (n=111)	1.8%	10.8%	16.2%	13.5%	31.5%	26.1%
Winetech final reports (n=111)	0.9%	9.0%	11.7%	20.7%	25.2%	32.4%
Facebook (n=111)	16.2%	6.3%	6.3%	3.6%	9.0%	58.6%
Winetech Technical Yearbook (n=111)	1.8%	3.6%	11.7%	17.1%	38.7%	27.0%
South African Journal of Enology and Viticulture (n=109)	0.9%	4.6%	11.0%	17.7%	37.9%	33.9%
Instagram (n=109)	12.8%	1.8%	8.3%	0.9%	4.6%	71.6%
Twitter (n=110)	10.0%	1.8%	5.5%	0.9%	4.5%	77.3%
Webinars (n=109)	0.9%	3.7%	7.3%	8.3%	18.3%	61.5%
LinkedIn (n=110)	2.7%	4.5%	3.6%	2.7%	8.2%	78.2%

The results in Table 6.9 are ordered in terms of frequency of use from the most to the least used. It should be noted that the availability of the resources significantly influenced the results. For instance, the internet and supplier websites are readily available, whereas the printed *WineLand* magazine is published monthly and posted to wineries. *Winetech Scan* emails are sent monthly to winemakers, and the *Winetech Technical Yearbook* is published yearly. Oenology textbooks are expensive and not standard in wineries, and new editions with up-to-date information are not published regularly.

Regarding winemaking scientific journals, only the *South African Journal of Enology and Viticulture (SAJEV)* and *Oeno One* are open access. *The Australian Journal of Grape and Wine Research* and the *American Journal of Enology and Viticulture* are both subscription journals. Vitis is an open-access journal but mainly focuses on viticulture research. Therefore, one must apply different lenses to make sense of the results in Table 6.9.

The most frequently used source of written information consulted is the internet, with 42% of respondents consulting the internet for winemaking information at least once a week. The second and third most consulted sources are supplier websites and emails, further highlighting the importance of this group of intermediaries amongst winemakers.

However, if one combines the results for "once a week" and "once a month", which is the frequency of publication for *Winetech Technical* in *WineLand* magazine, then the printed magazine becomes the third most consulted written source of winemaking information (44%).

If one compares the two email types, from suppliers and Winetech, the supplier emails are more readily consulted. This is to be expected since there are more than 74 suppliers of products and services in the SA wine industry (see Chapter 3). It is therefore not surprising that winemakers engage more with supplier emails than with *Winetech Scan* emails. In this case, it is best to look at the respondents that never engage with emails, which results in 12% of respondents never engaging with supplier emails and 24% never engaging with *Winetech Scan* emails. These results then confirm a higher preference for supplier emails.

Supplier emails usually contain a combination of factual, practical and commercial information. In contrast, the *Winetech Scan* contains mainly the latest SA and international research results that may or may not have direct practical applications. Suppliers also usually tailor their newsletters to contain information relevant to winemakers at that particular time, whereas the *Winetech Scan* reports on research results as it becomes available. One can hypothesise from the email results that winemakers are more inclined to engage with information that is relevant to them at that moment, and that is more practical.

An interesting find was that respondents 'preferred' reading technical articles in the printed *WineLand* magazine as opposed to reading the same articles on the *WineLand* website. It could be because of convenience. The magazine is delivered to them and usually ends up lying on their desks, meaning it is easy to casually page through while having a cup of coffee; for the website, they must actively search for something. During the interviews, winemakers confirmed "paging through" or "scanning" the *WineLand* magazine, looking for something that might interest them. No one commented on "scanning" websites for something interesting. Winemakers use websites to look for something specific when they have a problem or want to learn about something new. One can therefore argue that the printed magazine promotes 'accidental' learning.

Oenology textbooks were the fifth most consulted written resource (in terms of "at least once a month", 24%), despite their cost and potential lack of availability of the latest editions. Academic researchers usually write oenology textbooks. Various international oenology textbooks are available in SA, but locally produced books don't exist. This is in contrast with various South African-produced viticulture-related books.

Regarding scientific publications, a surprisingly positive result was obtained compared to what was expected, with only 26% of respondents indicating they had never read scientific articles. More than 12% read scientific articles at least once a month. This result was suspected to be overly optimistic. It was investigated in the qualitative component of this study, which confirmed the suspicion that winemakers did not quite understand what was meant by a scientific journal. One winemaker thought *The Australian and New Zealand Wine Industry Journal* was also a scientific journal; in reality, it is a practitioner magazine. The result must therefore be treated with caution. *The South African Journal of Enology and Viticulture* was one of the least preferred sources of written winemaking information, with 33.9% of respondents indicating they never consulted it.

The results indicate that social media platforms are the least preferred sources of technical winemaking information, scoring more than 50% of respondents never using it for that purpose. Facebook performed the' best' of all the social media platforms, with 16% of respondents indicating they use the platform at least once weekly for winemaking information.

Webinars were rarely used as a source of technical winemaking information (62% of respondents never used them). It should be noted that the web survey part of the study was performed before the onset of the COVID-19 pandemic, which resulted in worldwide restrictions on the movement of people and the proliferation of webinars to replace face-to-face knowledge transfer events. The result might have looked differently if the survey had been conducted during the pandemic.

The following section presents the results of the frequency with which winemakers attend knowledge transfer events. The availability of these events influenced the results. For instance, winemaker study groups or tasting groups can be as frequent as once a month, whereas the South African Society for Enology and Viticulture conference is annual. These results are therefore best interpreted by comparing the proportions of respondents never attending these events. Table 6.10 present the results to the question: "On average, how often do you attend the following events to obtain new or existing winemaking (oenology) information?"

Table 6.10: The frequency with which winemakers attend knowledge transfer events

	4+ times a year	**Three times a year**	**Twice a year**	**Once a year**	**Never**
Winemaker study/tasting groups (n=111)	67.6%	12.6%	10.8%	7.2%	1.8%
Supplier/service provider seminars (n=110)	23.6%	24.5%	25.5%	22.7%	3.6%
Cultivar group seminars (n=111)	14.4%	19.8%	27.0%	24.3%	14.4%
Stellenbosch University short courses/workshops (n=111)	1.8%	0.0%	9.0%	31.5%	57.7%
International vine and wine conferences (n=111)	0.0%	0.9%	1.8%	31.5%	65.8%
SASEV conference (n=111)	0.0%	0.0%	0.0%	28.8%	71.2%
SASEV workshops (n=111)	0.0%	0.0%	0.0%	18.9%	81.1%

The results are presented in the order of the most frequently attended to the least frequently attended. The most frequently attended knowledge exchange events are winemaker study and tastings groups, with 68% of winemakers indicating that they attend these events more than four times a year, and only 2% have never attended such events. Supplier seminars are the second most popular (only 4% never attend). This result, like the results for people and written materials in the case of suppliers, confirms the importance of this group of intermediaries for winemakers in the SA wine industry.

Cultivar group seminars are the third type of event that 14% of winemakers indicated they never attend. The programme usually contains technical and marketing information and is almost always accompanied by a wine tasting. Practical information regarding how award-winning wines have been produced is also provided.

The events involving academic researchers happen only once or twice a year or, in the case of SU short courses and workshops, are only ad hoc. The percentages of winemakers not attending these events are very high, ranging from 58% for SU short courses and workshops to 81% for SASEV workshops. The latter has subsequently been discontinued due to a lack of interest from the industry. Surprisingly, 32% of winemakers indicated that they attend international conferences once a year. Winemakers regularly participate in international wine shows and exhibitions that can also present some technical talks. It is possible that winemakers viewed those talks as a form of a conference while the real purpose of the question was only to obtain information on attending international academic conferences. Winemakers poorly attend the SA wine industry's academic conference, with 71% that indicated that they never attend it.

In the next section, the same 36 sources of knowledge were evaluated, albeit through a different lens.

6.3.3 KNOWLEDGE SOURCE CREDIBILITY

Source credibility is the extent to which a knowledge recipient perceives the source as reputable and trustworthy (Ko, Kirsch & King, 2005). The same 36 knowledge sources (as in Tables 6.7, 6.9 and 6.10 above) were presented to winemakers, and they were asked to rate how trustworthy they perceived or believed these knowledge sources to be in terms of the accuracy of wine science communicated, even if they don't consult with these resources. According to available literature, trust in a knowledge source can facilitate knowledge transfer (Battistella, de Toni & Pillon, 2016; Rutten, Blaas - Franken & Martin, 2016; De Wit-de Vries et al., 2018). The results are presented in Tables 6.11, 6.12 and 6.13.

Table 6.11: Winemakers' ratings of trustworthiness of people providing winemaking knowledge

	Very trustworthy	Generally trustworthy	Sometimes not trustworthy	Definitely not trustworthy	Weighted average
Stellenbosch University researchers (n=106)	42.5%	54.7%	2.8%	0.0%	1.60
Winemaking colleagues at your cellar (n=105)	45.7%	46.7%	7.6%	0.0%	1.62
Winetech employees (n=106)	35.8%	62.3%	1.9%	0.0%	1.66
Nietvoorbij researchers (n=105)	36.2%	57.1%	5.7%	1.0%	1.71
Winemakers in your area (n=110)	33.6%	60.9%	5.5%	0.0%	1.72
Analytical laboratories' personnel (n=107)	28.0%	64.5%	7.5%	0.0%	1.79
Industry opinion leaders/mentors (n=110)	23.6%	65.5%	10.9%	0.0%	1.87
Winemakers in other areas (n=108)	18.5%	72.2%	9.3%	0.0%	1.91
Local winemaking consultants (n=109)	11.0%	75.2%	11.9%	1.8%	2.05
Suppliers of oenological products/machinery (n=110)	12.7%	56.4%	30.9%	0.0%	2.18
International winemaking consultants (n=109)	7.3%	68.8%	21.1%	2.8%	2.19

A comparison between the frequency of consultation with specific groups of people and the assessment of the reliability of those people as sources of knowledge reveals an interesting picture. According to Table 6.7, winemakers most frequently consult with other winemakers and suppliers for winemaking information. Academic researchers are listed at the bottom of the list. According to Table

6.11, however, respondents indicated that they find the information received from Stellenbosch University researchers the most trustworthy in terms of the accuracy of wine science ("very trustworthy" and "generally trustworthy" responses combined, 97%). They also find the information obtained from winemakers at their own cellars also very trustworthy in terms of the accuracy of wine science ("very trustworthy" and "generally trustworthy" responses combined, 92%). Even though frequently used, suppliers of oenological products and machinery moved to almost the bottom of the list with the highest percentage (31%) for "sometimes not trustworthy". This discrepancy between frequently used and low levels of trust was explored in the qualitative phase of the empirical study and is elaborated on in a later section.

Winetech employees and Nietvoorbij researchers, seldomly consulted according to Table 6.7, are, according to Table 6.11, also perceived to be very trustworthy in the accuracy of wine science. Local and international consultants occupy the bottom half of the list regarding trustworthiness, which correlates positively with their lower frequency of use.

Table 6.12 demonstrates winemakers' level of trust in terms of the accuracy of wine science in written sources of winemaking information. As seen in Table 6.11, there is also a difference between the frequency of resource use (Table 6.9) and the level of trust.

Table 6.12: Winemakers' ratings of trustworthiness of written resources of winemaking information

	Very trustworthy	**Generally trustworthy**	**Sometimes not trustworthy**	**Definitely not trustworthy**	**Weighted average**
Oenology textbooks (n=110)	60.0%	38.2%	1.8%	0.0%	1.42
Winetech final reports (n=107)	49.5%	49.5%	0.0%	0.9%	1.52
SAJEV (n=108)	47.2%	50.9%	1.9%	0.0%	1.55
Winetech Scan (n=108)	43.5%	55.6%	0.9%	0.0%	1.57
Winetech Technical in *WineLand* magazine (n=110)	42.7%	55.5%	1.8%	0.0%	1.59
Scientific journals (n=109)	37.6%	58.7%	3.7%	0.0%	1.66
Supplier and service provider websites (n=110)	16.4%	63.6%	20.0%	0.0%	2.04
Supplier and service provider emails (n=109)	15.6%	63.3%	21.1%	0.0%	2.06
International trade magazines (n=109)	11.9%	69.7%	18.3%	0.0%	2.06
Webinars (n=104)	6.7%	74.0%	19.2%	0.0%	2.13
An internet search of the topic (n=109)	5.5%	55.0%	38.5%	0.9%	2.35
LinkedIn (n=104)	1.9%	23.1%	59.6%	15.4%	2.88
Facebook (n=106)	0.9%	16.0%	62.3%	20.8%	3.03
Twitter (n=103)	1.0%	18.4%	54.4%	26.2%	3.06
Instagram (n=105)	1.0%	17.1%	55.2%	26.7%	3.08

The written materials with researchers and Winetech employees as authors were considered the most trusted regarding the accuracy of wine science. According to Table 6.9, supplier and service provider websites and emails, after the internet, the most frequently used sources of written knowledge, were sometimes not trustworthy at 20% and 21%, respectively. The internet, the most frequently used source of written information, was regarded by 39% of winemakers as "sometimes not trustworthy", which places it at almost the bottom of the trustworthy list, just above the four examples of social media. This implies a negative association between usage and trust. The examples of social media received the highest percentages for "sometimes not trustworthy". Social media also received 15% (LinkedIn) to 27% (Instagram) ratings for "definitely not trustworthy", where these ratings were absent or almost absent (1%) for all the other knowledge sources. The social media results positively correlate with their high percentages of "never" used, as indicated in Table 6.9.

Table 6.13 demonstrates winemakers' level of trust in terms of the accuracy of wine science for events they attend. Again, there is a noticeable difference with Table 6.10, the frequency of events attended.

Table 6.13: Winemakers' ratings of trustworthiness of events providing winemaking information

	Very trustworthy	Generally trustworthy	Sometimes not trustworthy	Definitely not trustworthy	Weighted average
Stellenbosch university short courses and workshops (n=108)	43.5%	53.7%	2.8%	0.0%	1.59
SASEV workshops (n=107)	43.0%	55.1%	1.9%	0.0%	1.59
SASEV conference (n=108)	41.7%	55.6%	2.8%	0.0%	1.61
Cultivar group seminars (n=109)	33.0%	64.2%	2.8%	0.0%	1.70
International vine and wine conferences (n=107)	33.6%	61.7%	4.7%	0.0%	1.71
Winemakers' study groups and tastings (n=109)	31.2%	64.2%	4.6%	0.0%	1.73
Supplier and service provider seminars (n=109)	19.3%	62.4%	17.4%	0.9%	2.00

According to Table 6.10, the knowledge transfer events most frequently attended by winemakers are study and tasting groups, supplier and service provider seminars and cultivar group seminars. The events involving academic researchers were the least frequently attended (58% - 81% never attended these events). However, in terms of their credibility ratings (Table 6.13), three of the events involving academic researchers were voted the most trustworthy (44%, 43% and 42% "very trustworthy" responses). Stellenbosch University's short courses and workshops were rated the most trustworthy event regarding the accuracy of wine science. The two most frequently used events were rated the least trustworthy, with supplier and service provider seminars having the highest percentage of "sometimes not trustworthy" responses (17%). Despite this relatively high "sometimes not trustworthy" rating, the rating of "very trustworthy" for the same event is marginally higher at 19%. Combining the latter with the percentage of "generally trustworthy" responses for that event leads to 82% of winemakers reporting trustworthiness. This trustworthiness rating for supplier and service provider seminars is also markedly higher than that of nine written resources and two groups of people.

6.3.4 WINEMAKERS' RELATIONSHIP WITH ACADEMIC RESEARCH AND THE DEPARTMENT OF VITICULTURE AND OENOLOGY

This section explored winemakers' interest in oenology research and familiarity and interactions with DVO researchers. Participants were asked to indicate their level of agreement with two statements regarding oenology research. According to the results, respondents are very interested in the results from academic research with a slightly higher interest in international research (35% strongly agree and 51% agree) than results from the DVO (37% strongly agree and 46% agree). These results correspond with the credibility ratings winemakers gave academic resources. Winemakers' research interest does not necessarily align with their frequency of academic resource use, except for *Winetech Technical* in *WineLand* magazine. This can be because articles in this magazine are "filtered" through intermediaries (Winetech personnel), ensuring the facts' clarity.

Table 6.14: Winemakers' level of agreement with statements related to oenology research

	Strongly agree	**Agree**	**Indifferent**	**Disagree**	**Strongly disagree**
I am interested in the latest international oenology research. (n=111)	35.1%	51.4%	10.8%	1.8%	0.9%
I am interested in the latest oenology research at the DVO. (n=111)	36.9%	45.9%	12.6%	3.6%	0.9%

Participants were next asked to indicate their familiarity with DVO oenology researchers. Only 69% of valid respondents (n=111) indicated they are familiar with some of the oenology researchers working at the DVO. The result, in effect, means that more than 30% of the winemakers in this study were not familiar with any DVO oenology researchers, which could explain their lower utilisation of academic knowledge sources. This is despite the high interest in research results from the DVO and the high trust in the accuracy of wine science communicated by DVO researchers and short courses and workshops.

Figure 6.4 represents how the subset of respondents that reported familiarity with the oenology researchers at the DVO knows the DVO researchers. The different options were presented to the respondents, who could select more than one.

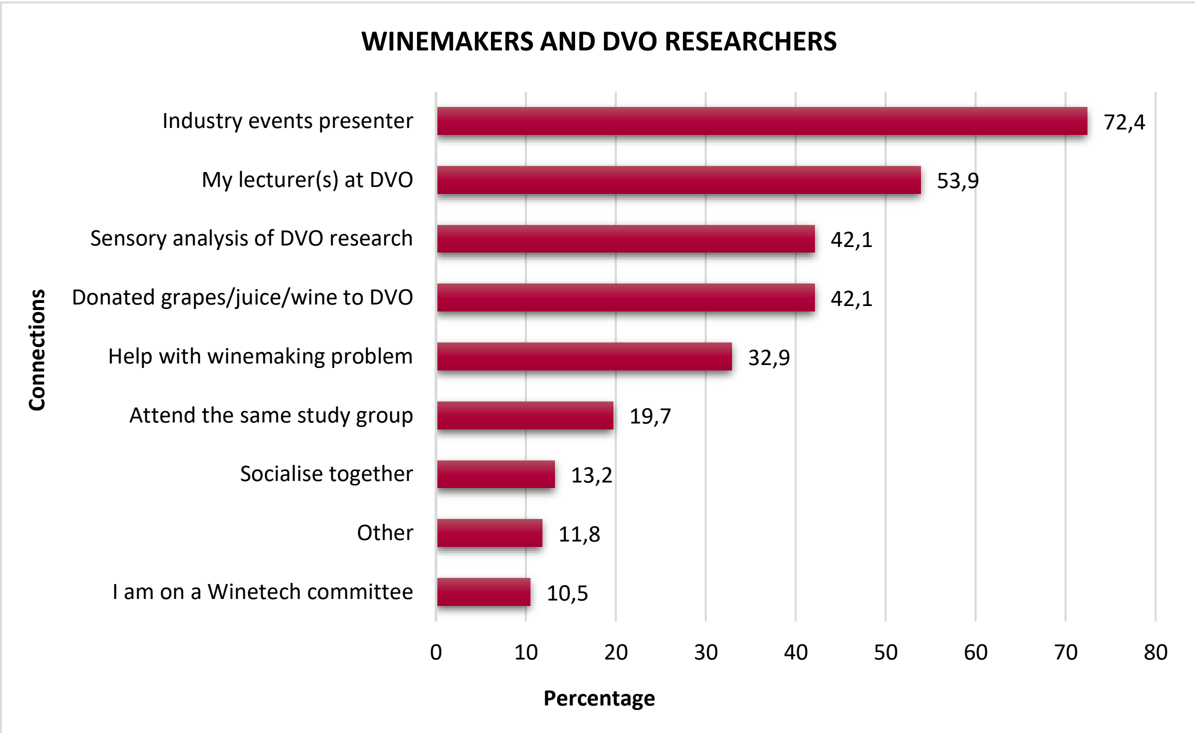

Figure 6.4: Winemakers' connections with DVO researchers (N = 76)

Most participants (72%) knew DVO researchers from attending events where they gave technical talks, indicating that this is a way for researchers to become more 'visible' and increase their social capital should they wish to do so. The 42% for both help with sensory analysis for research projects and the donation of grapes, juice or wine for research purposes indicates the willingness of winemakers to assist with oenology research projects. A third of the participants also indicated that they had asked oenology researchers for help with a problem showing recognition for their expertise. One way to interpret these results is if winemakers know the oenology researchers and their expertise, they might be more likely to engage with them regarding research projects and problem-solving (although this will depend on the problem).

6.3.5 WINEMAKERS' INNOVATIVENESS AND CENTRALITY IN THE KNOWLEDGE NETWORK

This section addresses two characteristics of winemakers that can influence their information-seeking behaviour. Highly innovative practitioners are usually very active information seekers, whereas so-called 'laggards' are usually the last to adopt innovations. The questions asked in the survey are roughly based on Rogers' categories of innovation adoption timing (Rogers, 2003). Results are presented in Figure 6.5.

Individuals central to a knowledge network can transfer knowledge to many other network actors, thereby enhancing innovation diffusion (Hoffman, Lubell & Hillis, 2015). Winemakers were asked how often other winemakers consulted them for advice to determine their centrality in the SA wine industry knowledge network. Results are presented in Figure 6.6.

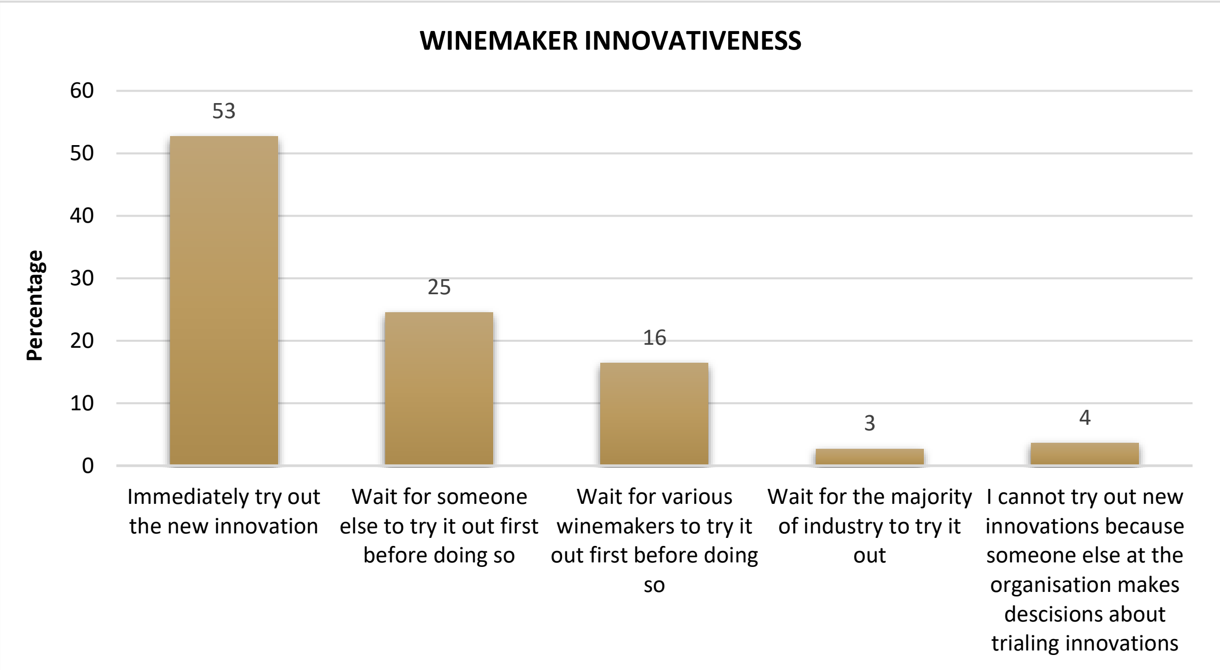

Figure 6.5: What winemakers would typically do when an (affordable) innovation that may apply to them becomes available (N = 110, percentages reported)

According to Figure 6.5, the winemakers surveyed exhibit a high degree of innovativeness, with slightly over half (53%) of the respondents indicating that they immediately try out an innovation. About a quarter (25%) will wait for one or more other people to try it out first before trying it themselves. A tiny percentage (3%) will wait for most of the industry to use the innovation before they try it out. Another small percentage (4%) indicated that they could not try out innovations due to someone else in the winery making those decisions.

In another question, where participants had to indicate their level of agreement with statements, 4% strongly agreed, and 11% agreed that they are restricted in implementing innovations due to a more senior person being "set in their ways" (Table 6.15). Results from the interviews with intermediaries discussed in section 6.5.3.3 confirm the existence of "older" winemakers who do "recipe" winemaking and are not necessarily open to innovations.

Table 6.15: Winemakers' level of agreement with a statement regarding implementing new winemaking knowledge at their cellars

	Strongly agree	**Agree**	**Indifferent**	**Disagree**	**Strongly disagree**
I am restricted in implementing new winemaking knowledge due to a more senior person at the winery being "set in his/her ways." (n=109)	3.7%	11.0%	14.7%	39.4%	32.2%

According to the results presented in Figure 6.6., a large proportion of respondents (46%) indicated that they are asked at least once a month to give winemaking advice to other winemakers. A logical conclusion is that it is most likely more experienced winemakers that are consulted for advice. Data from the study confirm this conclusion, with 61% of respondents from the age group 40-49 and 60% of the age group 50-59 indicating that they are consulted at least once a month for advice. However, 48% of winemakers in the 30-39 age group are also consulted regularly, which can be viewed as a robust social learning culture amongst younger winemakers. These results were explored further during the interviews, where winemakers were asked what their information-seeking procedure is when they encounter a problem they cannot solve themselves or when they would like to implement a new technology for which they need information.

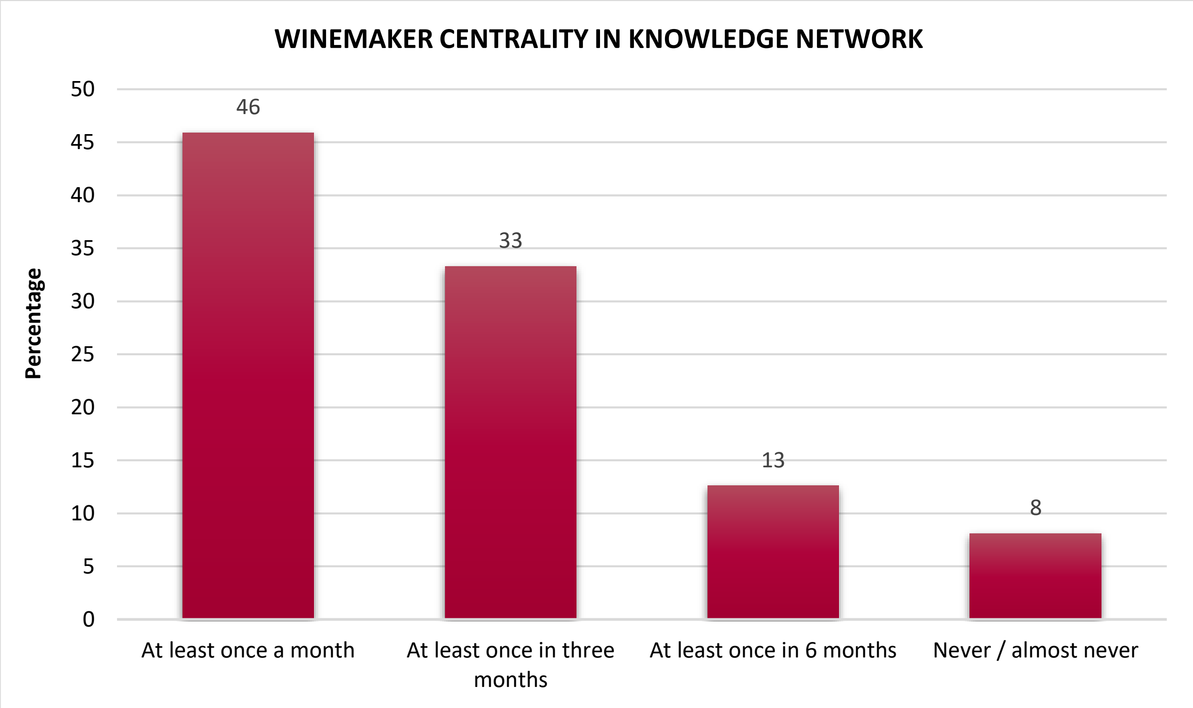

Figure 6.6: How often do fellow winemakers ask respondents for advice (N = 111)

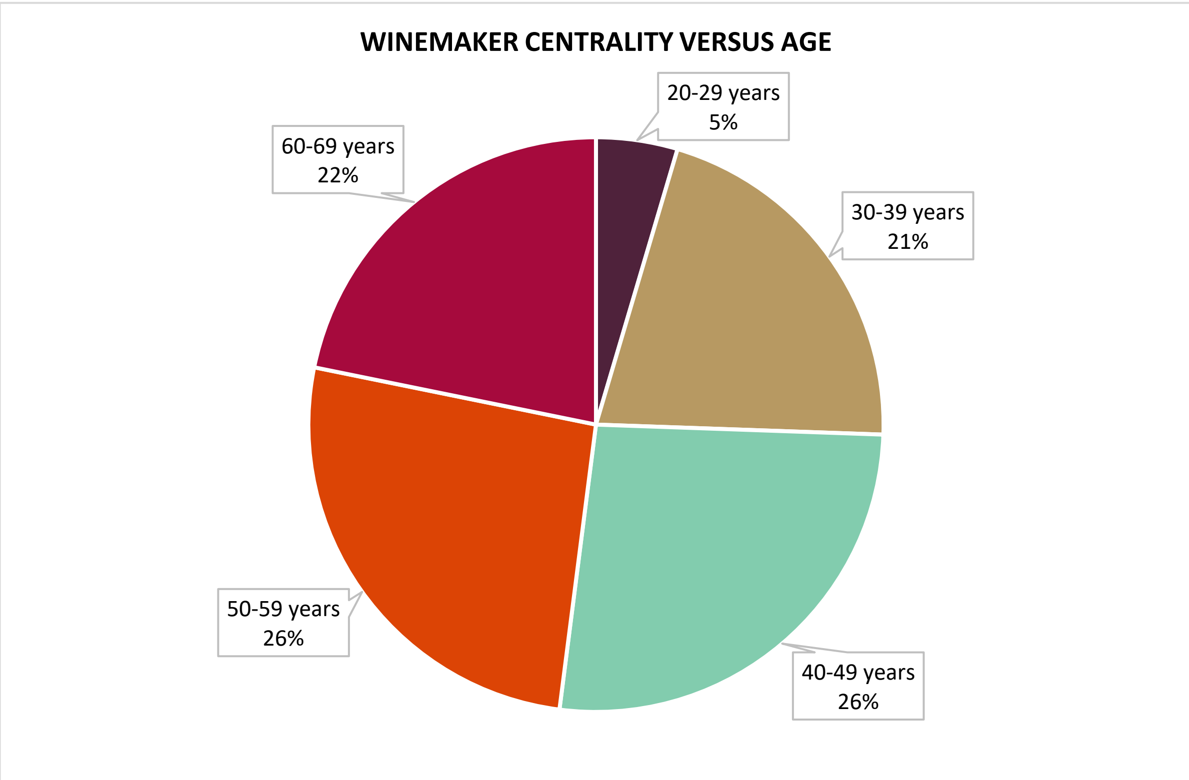

Figure 6.7: Age breakdown of winemakers that are asked for advice at least once a month (N=46)

The second biggest group of respondents (33%) indicated that they are asked for advice at least once in three months, and only 8% indicated that they are never or almost never asked for advice. The results suggest that the winemaker network is quite active in knowledge exchange, and most winemakers belong to this knowledge network. The industry also seems to have a large group of 'opinion leaders' assisting in the diffusion of innovation.

6.3.6 RESULTS FROM THE WINEMAKERS WEB SURVEY SUMMARY

The results demonstrate that South African winemakers show a high level of innovativeness. They use a wide variety of knowledge sources but prefer the interactive knowledge transfer channels, especially talking to their colleagues and winemakers in their area that they trust immensely.

Suppliers play a vital role in the winemaking knowledge network even though they score lower than other sources in terms of trustworthiness ratings.

Winetech Technical in the practitioner magazine, *WineLand*, is the most frequently consulted source of factual knowledge with high credibility. Other resources directly connected to academic research and researchers are less frequently consulted or attended despite their high trustworthy ratings, even though respondents indicated they are interested in research results. The frequency of communication (tie strength) between academic researchers and winemakers is low (32% of total survey respondents never engaged with them, and 28% engaged with them less than once a year). Even though academic research and researchers are very well trusted, the lack of communication negatively influences the DVO's 'social capital'. This is evident in the low number of respondents (n=76) who indicated they are familiar with oenology researchers at the DVO. The DVO researcher–winemaker relationship was further explored in the qualitative interviews, and the insights are presented in section 6.4 below.

As a final thought, some winemakers (30%) thought they possessed enough winemaking knowledge. This can also be a factor that can influence their use of knowledge resources and their uptake of innovations.

Table 6.16: Winemakers' level of agreement with statements related to their winemaking knowledge

	Strongly agree	Agree	Indifferent	Disagree	Strongly disagree
My current level of winemaking knowledge is enough for me. (n=111)	0.0%	29.7%	24.3%	37.8%	8.1%

6.4 QUALITATIVE FOLLOW-UP OF SURVEY RESULTS OF FIVE WINEMAKER TYPES

This section provides the results from semi-structured interviews with purposefully selected respondents from the web survey. The interview data was viewed through five broad lenses. Each lens had its emphasis. They are the following:

- Contextualised insights into the information sources of winemakers that are very interested in academic research (geeks),
- An understanding of why some winemakers are not interested in academic research (eschewers),
- Insights into winemakers' sales and marketing activities and if they influence their information-seeking behaviours (marketers),
- Establishing the role of suppliers as intermediaries in the industry (supporters) and,
- Whether younger winemakers have different resource preferences than older winemakers (millennials).

The same interview schedule was used as a framework for questions for all 20 participants. Participants were asked about their resource use regarding problems solving and innovation processes. Depending on the winemaker type, specific questions were discussed in greater detail than others to provide understanding and insights into the five identified lenses. Participants' views on oenology research and their relationship with DVO oenology researchers and the DVO were also explored.

Previous winemaker and grape grower academic studies segmented South African grape growers according to resource use (Dippenaar, 2017), South African winemakers according to knowledge use (Boshoff, 2012) and American winemakers according to attitudes towards winemaking (Szymanski & Davis, 2015). In these studies, the different typologies were distinct, whereas, in the current study, some winemakers could fit into more than one type. The results are presented according to the resources used, and direct quotes support the reported findings.

6.4.1 WINEMAKER TYPES

6.4.1.1 Geeks

The purpose of this segmentation was to obtain insights into the information-seeking behaviours of winemakers that are very interested in scientific research (factual knowledge). Additional filters were applied to deliver those who are also innovative and who are often asked for advice. Such innovative winemakers, who are central in their social networks (opinion leaders), can share factual and experiential knowledge with many other winemakers, enhancing the diffusion of innovations (Rogers, 2003; Hoffman, Lubell & Hillis, 2015). Practitioner peer groups must contain some practitioners that are very exposed to new knowledge because, without such individuals, new knowledge flow can become limiting (Dippenaar, 2017). It was, therefore, essential to establish where these winemakers obtain their information due to their importance in the knowledge network of the SA wine industry.

6.4.1.2 Eschewers

This group was selected to understand better why they (eschewers of research) indicated that they are either not interested in academic research results or feel indifferent about it. According to Szymanski and Davis (2015, p. 271), the assumption "that research is worth disseminating" and "that winemakers who do not employ research-based practices are not listening and need to be convinced" is unwarranted in the light of how winemakers practice their profession. The authors propose that one must instead assume that winemakers can have reasons for their attitudes toward academic research based on their expertise and social contexts. The expertise and social contexts of eschewers were thus investigated better to understand their lack of interest in scientific research.

6.4.1.3 Marketers

This segmentation aimed to establish whether increased sales and marketing activities negatively influenced winemakers' access to new winemaking information. Winemakers who indicated that they spend more than 20% of their time on sales and marketing-related activities were selected and prompted about the influence of these activities on their winemaking activities.

6.4.1.4 Supporters

Suppliers of oenological products and services fulfil the role of intermediaries in the South African wine industry. According to Battistella et al. (2016), intermediaries play an essential role in mediating the relational context of innovations and in communicating the benefits and the limitations thereof.

This group was selected based on their high frequency of interaction with oenological products and services suppliers and their resources, such as their websites and email communications. Table 6.17 indicates the Supporters' interactions with supplier resources as obtained by the web survey.

Table 6.17: Supporters' interactions with supplier and service people and resources

Resource	Supporter 1	Supporter 2	Supporter 3	Supporter 4
Supplier/service provider (person)	Once a month	Once a week	Once a week	Once a month
Supplier/service provider website	Once a week	Once a week	Once a week	Once a month
Supplier/service provider e-mails	Once a month	Once a month	Once a week	Once a week
Supplier/service provider events	Three times a year	Twice a year	4+ times a year	Three times a year

Although not selection criteria, all four supporters indicated they use either a local or an international expert consultant. They are also the group that most actively utilised the internet, i.e., once a week, for winemaking information. No other group showed such a high frequency of internet usage.

6.4.1.5 Millennials

This group was selected based on age and indication that they, like the geeks, were very interested in academic research. The idea was to establish if there was any specific pattern in their information-seeking behaviours due to their younger age (younger than 40) compared with the geeks (older than 40).

6.4.2 THE PROBLEM-SOLVING PROCESSES OF WINEMAKERS

The winemakers were asked what process they would follow if they encountered a problem in the cellar that required information they didn't already possess. Geek 1 indicated that he solves his problems mainly by consulting various written resources first and, if applicable, sending a sample of the wine with the problem to an analytical laboratory. The written resources he consults comprise the internet, *Winetech Technical* articles in *WineLand* magazine, his files with copies of interesting articles and his notebooks from various years.

"Say, I page through WineLand, and there is a very interesting piece on filters or pinking in Sauvignon blanc or anything. I make a copy, read through it, mark the most important three or five points, and throw it in a file named 'Things to learn'. So, when I have problems, I page through my 'Things to learn' file where I have lots of information." Geek 1 (translated from Afrikaans)

Geek 2 reported immediately phoning someone he considers to be knowledgeable on the topic, usually a supplier or service provider. He is particular about whom he will call. It must be someone he trusts in terms of their technical capabilities. According to him, there is no time for searching the internet in a problem situation since you struggle to find the information you are looking for timeously. When you speak to a person, they can direct you to a specific site or send you the written material you require, which means reading also forms part of his problem-solving process.

Geek 3 speaks mainly to suppliers and other winemakers for problem-solving and finds South African winemakers generally very willing to help.

"I really find that winemakers, young and old, man or woman, have always been willing to help. It is a blessing." Geek 3 (translated from Afrikaans)

Geek 4 consults his sources of written information first. He has compiled various topic-specific files over many years, containing articles from suppliers such as Laffort and Anchor Yeast and the Australian Wine Research Institute's (AWRI) website. If needed, he will contact his former mentor or a specific winemaking consultant.

Eschewers use the same sources of information for their problem-solving processes as geeks but in slightly different orders and frequencies. What stood out was their higher use of consultants, or in the case of Eschewer 2, technical people, to assist them with their problems. Another mentionable difference is the low usage of written resources for problem-solving, except for Eschewer 2, who indicated she uses the internet.

"My first thought will be to send the wine to {name of consultant} so that he can determine exactly what is going on. Then I will send a sample to Vinlab [analytical laboratory] to determine the chemistry of the wine or the

problem. After I have spoken to those two institutions, I will determine what supplier can help me with a product to sort the problem out, say, the two suppliers we trust for their knowledge, opinions and products." Eschewer 1 (translated from Afrikaans)

"My first stop would be other winemakers and technical people in the industry. And then obviously the internet and Google." Eschewer 2

"It depends on the problem. If it is a stuck fermentation, I will contact the supplier. It is also important to consult with Vinlab [analytical laboratory] to see what is going on in the wine. I think it will take too long to read. Searching takes time, and one is pressured for time at that point." Eschewer 3 (translated from Afrikaans)

Eschewer 4 indicated that he would contact his consultant, and if a product is needed, he will contact one of his trusted suppliers.

The problem-solving processes were quite diverse for the four supporters, with interestingly only one supporter indicating that, when encountering a problem, he will contact his suppliers first and then his consultant. According to him, "it is just easier to phone them [preferred suppliers] to follow up on stuff than for himself to start looking for information."

"We do a trial to see if it works. It usually does, and I think it builds trust." "So yes, I will go to my supplier first, or the people I know will be able to provide me with a solution." Supporter 2 (translated from Afrikaans)

Two marketers mentioned using a consultant to help solve their winemaking-related problems in addition to other winemakers, analytical laboratories and specific suppliers.

Millennials, like participants from the other groups, indicated that they would phone other winemakers and suppliers mainly, and some also indicated that they would call a consultant. Millennial 3 mentioned that he would have no problem contacting some of the researchers he knows at the DVO if needed.

6.4.3 THE INNOVATION INFORMATION-SEEKING PROCESSES OF WINEMAKERS

In this section, winemakers were asked what their information-seeking process would be if they were tasked with producing a wine they had never made. They could also refer to a specific innovation they recently implemented. This process can be different from the problem-solving process in that time to obtain the information is not so crucial.

Geek 1 referred to a wine yeast trial he did the harvest preceding the interviews. He obtained the idea for the trial from research results in a thesis he had read. After reading the thesis, he also spoke to the researcher and suppliers of wine yeasts. For a separate first-time trial in the same harvest, he talked to a supplier of the specific technology.

According to Geek 2, the best way to learn how to produce a new style of wine is to "find a winemaker who has done it before" and then speak to the suppliers of the products needed.

Geek 3 indicated his first step is to contact another winemaker who has produced the new style or trialled the innovation; then he will read about it and do a small experiment.

Geek 4 "will look at emailing or getting in touch with people who made it [new wine style] before." He will then read his notes and do an internet search. Finally, he will speak to an "open-minded" supplier. For him, gaining as much knowledge on the topic as possible before speaking to a supplier is very important.

"When I talk to somebody, I try and make sure I have the knowledge, so I don't get bulls.....t. So, I kind of almost like to do it the backwards way, but also, I can ask more penetrating questions about something if I have most of that knowledge already on tap." Geek 4

When seeking information to try something new, the eschewers obtain information from consultants, experienced winemakers and suppliers. Only Eschewer 3 mentioned searching the internet first before contacting people. None of the other mentioned consulting written resources.

Supporters 3 and 4 indicated they would contact other winemakers first for a new product or process information before contacting suppliers or "the university". Supporter 3 also revealed that after suppliers, she would contact her consultant and consult the *Winetech Technical Yearbook* containing plain language articles of research results. Supporter 4 indicated consulting with written resources as her final step in information seeking.

Apart from speaking to other winemakers and suppliers, all four millennials indicated that they would also consult written resources. Millennial 2 revealed that he would also consult with certain international researchers. Millennial 4 stated that he reads scientific articles as part of his information-seeking process. When asked if he is aware of open access articles, he was not familiar with the term but did realise that "in some cases, he can read the whole article and in other cases almost nothing."

6.4.4 RESOURCE USE BY WINEMAKERS: PEOPLE

Geeks speak mainly to other winemakers and suppliers that they trust. They all have preferred suppliers based on their trust in the technical knowledge of a specific employee, the products' successes and the company's reputation.

"I like the ability to speak directly with somebody like {person's name} from Laffort [supplier] who is quite an intelligent chap. They also have a good technical website. So actually, Laffort's one of the websites I tend to use quite a lot because it has a lot of really interesting information. Even if it is not relevant, you know, I can drift off with my ADHD into different topics – actually, nothing that I was supposed to be doing." Geek 4

One geek also referred to suppliers being "armed with a client list" of winemakers already successfully using the product and "armed with research" that supports the products.

Eschewers also speak to other winemakers and suppliers. They also have preferred suppliers. They base their preferences on the technical knowledge of the salespeople, the credibility of the companies they represent, the products' successes, the variety on offer and service delivery. Two companies mentioned by name as being preferred suppliers were: Laffort and Enartis.

In addition to speaking to other winemakers and suppliers, a less commonly used resource mentioned by a marketer included speaking directly with a researcher from the DVO.

All four supporters indicated that they have preferred suppliers. They base their selection of these preferred suppliers on various criteria such as being well priced, having sound technical knowledge, must understand the South African wine industry, having good payment terms, good products that work well, good service, sound advice and the name and reputation of the company. The two criteria mentioned by all four supporters were good products and the technical knowledge of the people they consult with. Supporter 1 indicated that he prefers working with certain people and will "follow" them for their technical expertise should they leave the companies they represent. Supporter 2 singled out two individuals working with two different companies for their technical expertise.

"Like with {name of individual}, the guy has many years of knowledge as well as knowledge about microbiology. It is a practical guy. The same with {name of individual}, she does not have that much practical experience, but her knowledge is excellent, and they are people you can always listen to. They give advice compared to the sales reps for {two other suppliers of oenology products}. They are just reps, and I will order commodity products like gelatine and similar from them. For my speciality products and if I need advice for my wines, I will always contact Laffort and Enartis because I feel they are people with knowledge of products and wine." Supporter 2 (translated from Afrikaans)

Supporter 1 confirmed that two groups of suppliers exist in the industry. Some are "only out to make a sale", and some "are willing to put sales aside and give technical advice."

Supporter 3 felt the credibility of the supplying company and the quality of its products are essential, as well as the knowledge of the person representing these companies. Another reason they regularly consult with suppliers is their centrality in the winemaker knowledge network. According to Supporter 3, they don't just have good technical knowledge; they also have practical knowledge of many other winemakers' product use, successes and failures.

"They speak to other winemakers in the industry and increase their own knowledge. Their web of knowledge is much more widespread than ours." Supporter 3 (translated from Afrikaans)

Supporter 4 also emphasised the importance of a long-term trusting relationship with specific suppliers based on their knowledge and the quality of the products they sell.

Like all the other interviewees, suppliers played a very prominent role in the information-seeking behaviours of millennials. According to the web survey, three millennials speak to their suppliers at least once a month and visit their websites at least once a month. The reason why the remaining millennial had less frequent interactions with suppliers and their resources was, according to him, because he produces only bottled fermented sparkling wine, and his information and product needs are therefore much less than the other three millennials.

Like the other interviewees, millennials have preferred suppliers they consult with for technical advice. Their preference is also based on trust in the persons, the products and the reputation and credibility of the companies they represent.

"We have an excellent relationship with our suppliers, and I think now more than a few years ago. They must know what they are doing, and I think most focus on giving you the right information. Everyone is willing to do trials, help you, and go the extra mile with you. Well, at least here at {name of company}. They are very trustworthy." Millennial 1 (translated from Afrikaans)

Millennial 2 mentioned that, unfortunately, the salespeople from suppliers are often under pressure to make a sale and don't always have the proper technical knowledge. It then happens that they cannot answer their (winemakers) questions, and it is essential for him that they are able. This statement can also explain why suppliers and their resources scored "sometimes not trustworthy" in the web survey more than other resources.

"The product that you need is determined by the volume, quality and price of the wine, and one appreciates it if a supplier tries to help you to solve your problem or if they try to help you to achieve your goal, rather than just

trying to sell you something. Some guys are commodity traders, which may be good business, but they are not the guys I will phone when I have a problem." Millennial 3 (translated from Afrikaans)

"There are two or three suppliers that I am more inclined to contact. Firstly, because we trust each other and have come a long way, and secondly, they represent big international companies known for their quality products. When they have helped, it went well." Millennial 4 (translated from Afrikaans)

6.4.5 RESOURCE USE BY WINEMAKERS: WRITTEN RESOURCES

A significant find from the geek interviews is their firm reliance on written materials in addition to people and events. Written materials form part of their problem-solving and innovation information-seeking processes. They use various written sources, including their own files, notes and books, internet sources, practitioner magazines, and academic sources. One participant boasted of spending years compiling his database, which comprises "something like 30 000 Word documents."

All four geeks continuously open emails they have opted to receive and scan the content for relevant information. If applicable, they read the entire article. They find emails to be a "huge source of information" with the added benefit of being "something you can read in your own time."

"I scan everything that comes through and see if anything is interesting, and then I read it and follow up." Geek 2 (translated from Afrikaans)

Three geeks found the *Winetech Scan* email (latest SA and international research results) particularly valuable, and three geeks also mentioned reading scientific articles on an ad hoc basis.

In addition, three geeks indicated they "scan" the *WineLand* magazine regularly. They only read some of the articles they find relevant at the time. Sometimes, when researchers write technical articles, the significance is not clear enough for them. When suppliers or Winetech write the articles, the "what" and the "why" becomes more apparent. One geek indicated he regularly reads *The Australian and New Zealand Grapegrower and Winemaker* magazine (Australia) and *Vines and Wines* (USA).

All the eschewers indicated in the web survey no or minimal use of written resources containing scientific information. Interestingly, two of them felt that their current level of winemaking knowledge is enough for them, and a third felt indifferent about the question (Table 6.16). This could partially explain why they don't engage with sources of research results since they feel equipped enough to do their jobs with their knowledge.

The eschewers were explicitly asked to give their reasons for not reading (eschewing from) the available written resources, with specific reference to *Winetech Technical* in *WineLand* magazine and the *Winetech Scan*, two resources that contain the latest South African and international research results. They had surprisingly different reasons, as indicated by these quotes:

"I always enjoy reading it [WineLand], but the time I have during the day, I mean, here at work, I sit behind my computer, and I do a lot of admin. Then, when I come home at night, I must bathe my children, feed them, and get them to bed. At 20h30, I am exhausted. I can't keep my eyes open to read a book. It is the sad reality of the phase of my life that I am in now." Eschewer 1 (translated from Afrikaans)

"It [Winetech Scan email] usually lies in my inbox for a week, and I know I must make time to read through it. And then, after a week, it is like, oh s..t, I didn't get to it. So, I might as well just move past it." Eschewer 1 (translated from Afrikaans)

"Now I don't get them (WineLand magazines) anymore. I must actually follow up on that." Eschewer 2

"In many cases, the articles [in WineLand and the Winetech Scan] are about research, and it is not yet in practice." Eschewer 3 (translated from Afrikaans)

"I would rather read an article about a product already on the market." Eschewer 3 (translated from Afrikaans)

Eschewer 4 felt that the articles in *WineLand* magazine were irrelevant to him; he did not like how it was written, nor did he have the time to read them. According to him, with his level of experience and the type of things he "works with," the information is not so relevant. In terms of the *Winetech Scan*, which he does read once a month (the frequency with which it is published), he feels it is a good way to disseminate new information and scans it to see if there is anything relevant to him. However, he thinks that if the information is available in such a format, the experts he consults with will also already have the knowledge. This last statement is debatable since, unless his consultants are academics, chances are slim that they have access to subscription-based academic journals, which is where most of the content for the *Winetech Scan* is derived from.

In general, marketers are not big readers of factual winemaking information. They prefer speaking directly to sources of information. Marketers 2 and 3 find the style of the oenology articles in *Winetech Technical* in *WineLand* magazine to "not be in a fascinating form" and "boring." Marketer 2 suggested that the articles should be more "storytelling style and digestible".

For supporters, the internet stands out as the most frequented source of winemaking information. One supporter mentioned visiting specific sites in addition to general searches.

"Yes, Winetech and WineLand have nice information. Sometimes UC[25] *Davis, if you can find some of their articles, then it is good. And then the AWRI*[26] *is also a nice source to look at. Other than that, I do general searches, but with the mentioned sites, I find nice technical articles."* Supporter 1 (translated from Afrikaans)

Winetech Technical in *WineLand* magazine was mentioned by two supporters specifically as one of their preferred resources.

"So, this is where I think the technical part of WineLand is technical and practical and further down the line [of research] with something you can use." Supporter 1 (translated from Afrikaans)

"In all honesty, it is the only part of WineLand magazine that I read. I am not interested in the other stuff. I usually page to the technical part first to see what is there and what is new and available. I feel the length of the articles, in my opinion, is perfect. Two to four pages for an article is ideal for understanding the research. It is summarised very well. I know it is not the whole article published there, but there are usually many graphics, which are great for a winemaker to understand. We are B.Sc. trained, but if you read a research article, you don't want to read all the materials and methods. I want a summary to understand what this research can offer winemakers. I am not complaining, nor do I have advice on improving it [articles in Winetech Technical]. I think it is perfect for me to understand. Supporter 3 (translated from Afrikaans)

Supporter 3 also referred to the *Winetech Technical Yearbook*, a combination of all the technical articles published in *Winetech Technical* in a calendar year, as a great resource. She describes it as a resource that can help her "with decisions in the cellar."

Supporter 2 mentioned scanning *WineLand* and only reading articles that "catch his eye." He prefers reading articles with results from trials conducted in "reasonable size tanks" and "not just in a lab." For him, articles must have a clear, practical significance relevant to a large production size cellar.

"If it becomes too technical and not practical enough, then you lose me." Supporter 2 (translated from Afrikaans)

He had a similar sentiment about the *Winetech Scan* newsletter, indicating that when it gets "too technical", he gets lost, but "the practical stuff they use."

Supporter 4 felt the articles in *WineLand* can be too long sometimes and too technical. She prefers shorter articles with less information; if she wants more details after reading the article, she will investigate further.

"To run around the whole day and then sit down and start reading an article is somewhat intense." Supporter 4 (translated from Afrikaans)

[25] University of California, Davis

[26] Australian Wine Research Institute

Millennials, like geeks, also regularly consult with written resources, but not to the extent that geeks do, for various reasons. Millennial 1 indicated that she spends more time reading marketing and grape growing articles than winemaking articles because that is where she lacks knowledge.

"Winemaking information is available to me, but I won't necessarily look at it. Or I will think I can read it later since I studied it [winemaking] and probably know it already."

"The marketing part, I want to make sure that I improve, especially because we are now more exposed and [I am] trying to understand the business model. I feel that during the four years we study, we don't have classes explaining how to present a tasting and how to present your products to people. So, it is an unknown to me." Millennial 1 (translated from Afrikaans)

"I must say I read. It is always interesting to read the vineyard stuff [in WineLand magazine], especially since being on the wine side, I must improve my knowledge of it [viticulture]. I read the articles, and if they are very interesting, I will discuss them with colleagues or other friends in the industry. Most of the time, it is just, I read it, noted, and moving on type of thing." Millennial 1 (translated from Afrikaans)

Millennial 2 indicated that he "pages through" *WineLand* magazine. When there is an article "of interest" in the *Winetech Technical* part, he will read it. That part is the only part of the magazine he reads, even though he sometimes finds the articles too technical or the significance to him as a winemaker is not clear enough. He also mentioned that when you read something in a magazine or online, "you cannot smell and taste the results," and he prefers the practical demonstration of results, for instance, at seminars.

"The reason why I only page through WineLand is that it is old news. Everything in print is old news. That is the world we live in. Technology is more, you know, immediate, and print is unfortunately outdated. So, everything in front of the technical part is stuff you already know. So, it's like, oh, it is printed on glossy paper. It is not to be nasty; it is just how I view it." Millennial 2 (translated from Afrikaans)

"We understand it [articles in WineLand] is scientific and researchers write them, but it is practical people who read them. So, I think often there is too much emphasis on big scientific names or the methods and graphs. Graphs depend on how you interpret them unless someone is standing next to you saying look, this is what I mean… this is what they mean. So, I think sometimes the conclusion is a bit watered down or rushed, and maybe there can be better communication on exactly what the conclusions are on the results obtained. Millennial 2 (translated from Afrikaans)

Millennial 3 also indicated that he only pages through *WineLand* magazine and that if he spots something interesting or relevant to him, he will read it. He mentioned that most people will only consult written resources if they have a problem and that reading articles just for interest's sake is "unfortunately not something that happens naturally." He is very interested in research and consults *WineLand*, Winetech and *IVES Technical Reviews* websites when looking for information. When he does a Google search, he makes sure the source of information is credible. He pointed out that, unfortunately, the use of winemaking written resources remains a manual action and that they compete for the same attention span as social media sites.

"I think anything that will simplify the flow of information is positive, but we are still dependent on someone that must search for information. With social media, things are almost forced down your throat. Right or wrong. But you compete with all those information streams, and there is only so much capacity to take up all that information. So, if you are not part of that incoming information, you will always be in the background waiting for someone to search for you. And that search will, unfortunately, only be every time someone has a problem. I don't think guys sit around and say, hey, you know what? I am going to randomly read a bit about filtration. It is more like, oh sh%t, I have a major filterability problem, and I can't get my wine clean. I must look for information. And then we are once again curative." Millennial 3 (translated from Afrikaans)

"You compete for the same attention span of the same user. So, if your information is not relevant and engaging, then the guy will rather watch cat videos on Instagram." Millennial 3 (translated from Afrikaans)

Millennial 4 prefers having a dialogue to obtain new information than to read about it because of the ability it grants him to ask questions. He does read and even reads scientific papers, but usually only after hearing about something interesting or new from another person.

"The biggest thing that frustrates me is when someone sends me an e-mail saying: Hi, look what we have for you. There is no personality. So, I like it when someone sits opposite me, not too often, and talks to me, and I can ask questions, and he can answer or go look for answers." Millennial 4 (translated from Afrikaans)

He further suggests that "something must happen first" that induces a need for people to engage with newsletters, for instance, and used the example of bushfires near vineyards triggering winemakers to read about smoke taint in wine and how to minimise it.

6.4.6 RESOURCE USE BY WINEMAKERS: EVENTS

Various comments were made in terms of the attendance of events. Two geeks indicated that they like interactive events such as seminars, but geographical distance can sometimes be a problem. They also indicated that they would like to read the information presented on the day if they could not attend in person. They also try to send their assistant winemakers, who have less administrative and marketing responsibilities at the cellar and are eager to learn, to attend industry events.

It depends on your time; it is nice to hear from the horse's mouth what is happening. It is much easier because you can ask the person your five questions afterwards. But if your day does not allow it, then I ask to read it." Geek 1 (translated from Afrikaans)

"Here in the Sandveld, there is 'nothing' going on. Most of the stuff you get or want is far from you. You must use the internet." Geek 2 (translated from Afrikaans)

Two geeks mentioned in case they missed webinars (a common knowledge transfer resource during the COVID-19 pandemic in 2020 and 2021), they also preferred to read new information rather than watch recorded webinars:

"I don't like watching recorded webinars. I would rather read the whole 'he said, she said thing'." Geek 1 (translated from Afrikaans).

"I don't want to see it [recording of people presenting information] because we are not in Hollywood. Most normal people are uncomfortable in front of a camera, and I don't feel like wasting my time with such 'nonsense'. I want to read in my own time to get value out of it." Geek 2 (Translated from Afrikaans)

One geek was a bit weary of the information delivered by winemakers at seminars. He felt the "networking" aspect of seminars is very important but that the information shared by winemakers at such an event "is not always accurate."

One geek mentioned being part of a winemaker study group where a researcher was also involved. He reckoned such a platform could be very effective in exchanging new information.

Eschewers attend various events frequently, with winemaker study and tasting group meetings attended the most frequently, followed by supplier seminars and cultivar group seminars. The exception was industry conferences, especially the South African Society for Enology and Viticulture conference. Reasons for not attending SASEV conferences were that it is expensive, one does not necessarily want to listen to all the talks, and the theory is too distant from practice.

Eschewers 1 and 2 prefer seminars to written resources because at seminars, they can devote their attention 100% to the knowledge source. In contrast, one tends to get interrupted by phone calls and emails while trying to read something at work. Eschewer 3 finds seminars more practical with a wider variety of topics. Eschewer 4 mainly attends the study group and association he belongs to. According to him, there is an "astonishing amount of information" to be gained from the other winemakers at these events.

Three of the marketers indicated that they learn the most from other winemakers, specifically those who belong to their study group. They experience this interactive knowledge-sharing platform as extremely valuable and commented that their study groups contain a diverse set of winemakers with different specialities they can tap into. The study group participants also have different ways of obtaining new knowledge, with some regularly consulting written resources of factual winemaking information.

"At the {name of study group} is where I will question you. I will drive you crazy. It is the place where I learn." "The story's irony is that one learns from people younger than yourself, who are focused on specific things." Marketer 1 (translated from Afrikaans)

"There is a wide variety of people in the group. So, there is a bit of everything, including people who like to read stuff." Marketer 4 (translated from Afrikaans)

Marketer 3 liked the fact that his study group is very practical compared to the SASEV conferences, where "one must attend for two days and listen to talks with no practical message". He prefers the more interactive and practical approach to communicating research results. Another advantage of these interactive study group events is that it promotes 'accidental' learning. One comes to the event to obtain answers to specific questions and pick up other useful information and ideas. This is similar to what Geek 4 explained when he goes to a particular supplier's website to obtain the information he needs and tends to read much more than he set out to do.

The marketers also mentioned the cultivar associations' technical days as preferred ways to obtain new information. They like the idea that it is not a full-day seminar, the topics are diverse, and results are demonstrated through wine tastings.

Supporters regularly attend knowledge transfer events such as study and tasting groups with specific winemakers, cultivar association seminars and suppliers' seminars. Supporters 3 and 4, however, commented on the repetitive nature of some of the information given at workshops. Supporter 3 indicated that she prefers research results "to reach her through a written format."

"Many times, the information is repetitive, if I can put it that way. It is stuff that you already know. So, if you attend a seminar, you must attend the whole day, even if the most interesting part for you is at the end." Supporter 3 (translated from Afrikaans)

"15 years ago, I attended every workshop presented by every supplier. I have since realised that many topics are presented repeatedly and not just at supplier seminars. Yes, sometimes there is something new, but I feel at this point I cannot go to a Brettanomyces or malolactic fermentation workshop anymore." Supporter 3 (translated from Afrikaans)

Supporter 1 also pointed out that the advantage of written material over seminars is that you can access the information in your own time.

Regarding conferences, supporters are not interested in attending the SASEV conference, where new research results are presented, as demonstrated by their quotes.

"It is hopelessly too technical, and some of the SASEV events I don't attend anymore. It is too expensive, and at the end, you sit there for an hour and a half, and then the guys tell you the research is still in the research phase,

and feedback will be given later. Then I was excited for an hour about this invention, and they burst my bubble here at the end. I have experienced this many times." Supporter 1 (translated from Afrikaans)

"The days they host are sometimes very technical." "Us normal winemakers are not intelligent enough for it." Supporter 2 (translated from Afrikaans)

"It became a bit too much for me. I must be honest. It is an enormous amount of information that is given. So, it became a bit overwhelming for me. I have also found that many of my friends, other winemakers, also feel it is too much." Supporter 4 (translated from Afrikaans)

In general, millennials prefer to hear new information, especially in interactive sessions (seminars, study groups, tasting groups, one on one) where they can ask questions and hear the opinions and experiences of other winemakers.

6.4.7 RESOURCE USE BY WINEMAKERS: WEBINARS AND SOCIAL MEDIA

In the web survey, few participants indicated that they used webinars; however, the survey was conducted before the onset of the COVID-19 pandemic and restrictions on gatherings. The interviews were conducted after the pandemic's start, hence Marketer 3's positive experience with webinars.

"Something I appreciated or enjoyed taking part in are these webinars. Even though it is one-way communication, it is short and powerful. It is only an hour or two that you listen to them, and there is no travel time, and it doesn't take half a day or three-quarters of your day." Marketer 3 (translated from Afrikaans).

One winemaker mentioned using Instagram for learning about a specific wine style, and two winemakers mentioned using Facebook. Social media was not a popular choice for winemakers to receive winemaking information, as demonstrated by the web survey results (Table 6.9).

6.4.8 THE INFLUENCE OF SALES AND MARKETING ACTIVITIES ON WINEMAKING INFORMATION-SEEKING

All four marketers explained that their sales and marketing activities and time spent consulting with sales and marketing-related resources don't negatively influence their winemaking-related actions. In terms of interactions with winemaking resources, all four marketers reported that whilst they don't interact regularly, the winemakers they supervise do, and that new information, therefore, still reaches the cellar.

Of the four marketers, Marketer 1 indicated that despite all his marketing activities, he is still first and foremost a winemaker. During the harvest season, winemaking receives priority, and he will only engage in marketing activities at the physical cellar if time allows for it.

“My priority is to make wine. Marketing is an add-on. The moment I have a problem here [in the cellar], I will cancel my [marketing] responsibilities, and I will focus on solving my problems.” Marketer 1 (translated from Afrikaans)

Marketer 2 relies on her team of winemakers to gather winemaking information and, if needed, provide her with the “digested” version.

“At this stage, I ask my team if I have a question. When they return to me, I ask where they got the information, if they feel comfortable with it and if they think it is adequate.” Marketer 2 (translated from Afrikaans)

Marketer 3 relies on the “10 – 20 years” experience of the winemakers reporting to him for information seeking. He did indicate that he would have liked to spend more time engaging with winemaking information resources, but he does not have time in his current position.

Marketer 4 argued that his experience of what works in his cellar allows him to spend more time engaging in marketing activities. He will enable more junior winemakers to attend industry events if he does not have the time. He commented that he belongs to a winemaker study group that meets regularly and that his area's winemakers are very open to sharing information.

“Winemakers in this area are very open. We will phone each other and ask for advice, and if we hear about something, we will talk about it.” Marketer 4 (translated from Afrikaans)

The same question was also posed to winemakers segmented into the other groups since all 20 selected winemakers for the interviews indicated spending some time doing sales and marketing. Here mixed experiences and views were obtained. Four winemakers felt it did not affect winemaking information seeking, and four thought it did. The four that felt it did not, gave various reasons why they thought it was not the case. They argued that when you travel for sales and marketing, you often travel with other winemakers, which still leads to conversations and knowledge exchange about winemaking. In addition, they mentioned that marketing and winemaking are two separate actions, so theoretically, they should not influence each other. Lastly, since winemaking remains their primary task and takes priority, they ensure that sales and marketing activities do not affect it negatively.

In terms of the four that felt sales and marketing activities did influence their winemaking information-seeking behaviours, one winemaker specifically mentioned it hampered his ability to attend seminars. The other three also thought they were spending more time engaging with marketing information due to their positions at the cellars. Still, they did not view this as a negative since, as one winemaker explained, “winemaking is the easy part of my job,” meaning not much information is needed.

6.4.9 WINEMAKERS’ VIEWS ON OENOLOGY RESEARCH AND DVO RESEARCHERS

Winemakers were asked various questions regarding their relationship with oenology research and the South African oenology researchers. They all felt that conducting oenology research in SA was important because of local challenges and conditions.

“It is one of the most important parts to keep the industry strong and healthy.” Geek 1 (translated from Afrikaans)

“I think it is crucial. Just look at what has been achieved over the years. If you take it away, your industry will stagnate. You cannot just get information from Australia and those places since it is not always applicable to you and your environment. No, I think you should increase the research budget.” Geek 2 (translated from Afrikaans)

I think it is vitally important because it gives a perspective to South Africa rather than trying to mirror certain research that’s been done in another country with different variables.” Geek 4

Only two of the geeks could mention some DVO researchers by name. In general, they could not recall the DVO researchers’ specialities. However, this was not a concern for them.

“I haven’t seen a researcher here in 10 years.” Geek 1

“I don’t know because they don’t tell me.” Geek 3

“So, I don’t necessarily know who the lecturers are and who does what.” Geek 4

All four geeks acknowledged that winemakers could contribute to research projects, and all four indicated their willingness to communicate with researchers should there be a need.

Despite the lack of direct communication between the geeks and DVO researchers (weak tie strength), geeks interact with sources of codified scientific information regularly, as demonstrated in table 6.18.

Table 6.18: Geeks' interactions with written resources containing academic research results

	Geek 1	**Geek 2**	**Geek 3**	**Geek 4**
Oenology textbooks	Once a week	Once a month	Once every three months	Once a week
Winetech Technical[27]	Once a month	Once every three months	Once a month	Once a month
Winetech Scan[28]	Once a month	Once every three months	Once a month	Once a month
SAJEV[29]	Once a month	Once a year	Once every six months	Once every six months
Scientific articles	Once a month	Once a month	Once every three months	Once a month

Three of the geeks were aware of open access versus subscription-based articles, although one of the three was unaware of the term "open access." They all read the *South African Journal of Enology and Viticulture*, an open-access journal, and employ different tactics to obtain subscription-based articles. Geek 1 receives his articles mostly from suppliers from Italy and France. Geek 3 gets his articles from Winetech or contacts the author via email directly. Geek 4 gets his articles directly from authors via email, ResearchGate or Sci-Hub. He also mentioned using Google Scholar as a browser when searching for scientific papers.

Geek 2 had a different view about paywall articles:

"If I have to pay for it [scientific article], then he [the author] does not want me to know the information." Geek 2 (translated from Afrikaans)

The three eschewers who studied at the university all mentioned researchers by name and knew some of their specialities, which is a result one would instead have expected from the geeks. Despite being better acquainted with the researchers than geeks, they were either not interested in or felt indifferent towards the research conducted at the DVO. Two of them were interested in international research. The reason for the purposeful selection was to explore their disinterest or indifference toward research.

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[27] Monthly editions

[28] Monthly editions

[29] South African Journal of Enology and Viticulture - Biannual editions

Based on their answers about oenology research, the four eschewers did not question the value of oenology research being conducted in South Africa. Eschewer 1 specifically pointed out that she would prefer South African research results because “the climate, the soil and type of grapes (in other countries) are different from our reality in South Africa.”

Eschewers 1 and 3 indicated that they feel “indifferent” towards oenology research at the DVO and internationally for the same reason: they are only interested in a result they can implement. Eschewer 3 elaborated further by arguing that he is not interested in the research process either. The following quotes demonstrate their sentiments towards oenology research:

“If I can make my work better and easier, then it [research results] will be good, but I am also rather set in my ways, and I know what works in my set-up. So, I am prone to following the familiar path. So no, research is good, and it is nice to hear about it, but until it has spilt over to practice and has proven that it can work, it is almost background noise to me.” Eschewer 1 (translated from Afrikaans)

“So, as I said, I think it is because it is still in process. So, for instance, I will be very interested in saying, right, the research is completed, the product has been tested, and now we have results for the product. I am not that interested in the process, and the methods followed to do the research. I am more interested in going to supplier seminars, say roughly November, where they introduce their new products to the industry. I attend those because the research and the articles have been completed. The product was tested, and now we have it.” Eschewer 3 (translated from Afrikaans)

Eschewer 1 also mentioned that should her situation change regarding employment, her sentiments toward research might change, as she might find herself in unfamiliar territory and need specific information.

Both Eschewers 1 and 3 saw value in researchers consulting with winemakers with regards to concept applications for industry research funding, but Eschewer 1 also felt that researchers are generally “geared to do such things on their own.” Eschewer 3 indicated that he has helped researchers before and is willing to help again in evaluating certain aspects in practice.

Eschewers 2 and 4 were not interested in DVO research or felt indifferent about it, respectively. They were interested in international research. Eschewer explained her disinterest in DVO research is because of the department's lack of research diversity. Each researcher has his/her speciality and will continue to research in that speciality.

“So, everyone becomes more specialised in their area, so it just means that the research is getting more zoomed in on the same or similar topic.” Eschewer 2

“So, if you are looking at international research, you are getting a lot more diversity within the research space.” Eschewer 2

Eschewer 4 felt indifferent towards DVO research, not in terms of the actual research output, but because of his experience with final year oenology students' internships. Each year final year students are placed at different wineries to work the harvest and do a minor "research" project. According to Eschewer 4, the DVO offers very little assistance to these students. It almost looks as if it is only "an academic exercise", and they are "not really interested in the projects the students did." He elaborates further that when for instance, doing sensory analyses for research projects at the DVO, very little feedback is given afterwards on the results of the sensory analyses. There is a lack of communication and interaction from the DVO. For him, this is a disappointment, and he would like the DVO to play a more prominent role in the South African wine industry.

Regarding researchers interacting with winemakers in research projects, Eschewer 2 felt that researchers don't need to interact with many winemakers; they can interact with intermediaries, i.e., "reps from major oenology companies," since they know what the needs and problems of winemakers are. He also mentioned the importance of an intermediary such as Winetech to filter information from the DVO to make it more acceptable for winemakers.

Interestingly three of the eschewers indicated that they wait for someone else to try an innovation before they try, making them generally less innovative than the geeks. It could partly explain why they are less interested in research results.

Three marketers indicated that they know some of the current oenology researchers. However, three marketers felt indifferent towards international oenology research, and two were indifferent towards DVO research. One of them was not interested in DVO research at all. Most marketers, therefore, share a lack of interest in oenology research with eschewers.

The reasons given for their lack of interest in oenology research, as indicated by their quotes, were focus has shifted towards marketing information, no recent research projects proved directly beneficial, research results are not communicated clearly enough, research needs more research to obtain answers and, research not practical to implement in large cellars.

"The indifference is because I channel it [research information] to my team, and I receive only the processed form." Marketer 2 (translated from Afrikaans)

"I ask myself, what recent research has benefited me? I won't be able to answer you." Marketer 2 (translated from Afrikaans)

"It is the highly academic level in which the stuff [research] is written, and it boils down to a lot of reading, and I don't get the crux of the message of here is something that I can do or should not do. Often with these information days, one must listen to a lot of information, and at the end of the day, they say: This is what we found, but we

need more research to get to the answer. So, they are busy with something, but they have no idea where they are going and what is the answer. We [winemakers] want a practical answer to what the research is about." Marketer 3 (translated from Afrikaans)

"It depends on what it is about. Is it relevant? Can I use it under my conditions?" Marketer 4 (translated from Afrikaans)

"It depends on how you apply it [research results]. It is nice to know, but it is not necessarily practical to implement in a cellar where you harvest 1300 tons of grapes daily. For example, at one point, there was a lot of focus on YAN and whatever, but imagine, how must I test a million litres of juice daily? By the time I get the answer, I have already inoculated the yeast and added nitrogen." Marketer 4 (translated from Afrikaans)

Despite their lack of interest, all four marketers felt it was essential for South Africa to do oenology research. All four indicated they would be interested if the research was relevant in their cellars. Marketer 1, however, felt that the industry-funded research should be more practical. To him, the research is "very pie in the sky." The research must also be presented to him more practically. He does not want "to read books or look at graphs." According to him, research should only be funded if it is "practically executable and able to improve the quality of South African wine within a year." A statement like this can either be interpreted as the winemaker's lack of understanding of how academic research works or that the winemaker understands the academic system and is frustrated with it.

All four marketers felt that it could be beneficial for researchers and winemakers to communicate with each other.

- Marketer 1 suggested using representative winemaker focus groups to help researchers conceptualise projects for the industry.
- Marketer 2 felt that by allowing winemakers to give input in the research, they might be more open to assimilating the results when it becomes available. She also feels it will enable researchers to get a better idea of what the issues are that winemakers want answers for.
- Marketer 3 felt researchers visiting cellars can benefit winemakers since they might be able to identify improvements to practices due to their more extensive theoretical backgrounds, which they, as winemakers, are "blind" to.
- Marketer 4 felt if winemakers share practical information with researchers, they (the researchers) can potentially get results faster than if they had to obtain results by trial and error. He also felt it would be great if researchers could visit his cellar to experience how "larger concepts" operate.

The supporters felt that it is vital for oenology research to be conducted in South Africa. Three of them indicated they know one or two researchers at the DVO and could mention some of their research specialities. They noted that they are interested in "practical" (applied) research and willing to assist researchers with practical information and trials.

"Phone us or send an email and say listen, are you interested in being part of a study to help us. I know {the name of researcher} sends us emails about tastings. It is nice to be involved in such a way. They (the researchers) don't have to be shy or hesitate to contact us. We are open to such things." Supporter 2 (translated from Afrikaans)

All four millennials studied at the Department of Viticulture and Oenology (DVO), and two had master's degrees. They all knew DVO researchers and could mention the scientific fields of at least two of them. These are the same two researchers mentioned by various other winemakers. Thus, one can argue that they are the researchers with the highest 'social capital (tie strength + trust)' or the most 'visible' researchers among the 11 oenology researchers interviewed for this study.

All the millennials felt it vital that research be conducted in South Africa. Millennial 3, however, questioned the type of research being undertaken. According to him, oenology innovation lies mainly with certain price points and should be focused on process improvement. Especially for big volume producers, "one wants better expression at a lower price with fewer losses and things that [can] happen faster and cheaper." A lot of process improvement research is already conducted by machinery and product suppliers. According to him, viticultural research is more important for wine producers at higher price points, and what happens in the cellar remains the same; it is only a "fine-tuning" process.

"The whole approach to it [winemaking] is much more basic and part of the image." Millennial 3 (translated from Afrikaans)

"To me, it is as if the vineyard is more important, and the wine must only be a translation of it to a large degree." Millennial 3 (translated from Afrikaans)

Like all the other winemakers interviewed, millennials felt they could contribute to research conceptualisation if asked. However, Millennial 3, who has been part of such a process where researchers discussed their research proposals before applying for funding, experienced that the researchers usually already have a project and then consult with winemakers "to try and squeeze it into something 'relevant' for the industry." According to him, winemakers' most prominent question is "how to market their wines better to be more profitable," which is not something oenology researchers can help them with.

Millennial 4 felt that to narrow the gap between researchers and winemakers; researchers should "get out in industry more."

"Many spend their careers in front of a laminar flow cabinet, behind a pipette, or something like that."

"I know their primary job is in the laboratories, but if they want a better relationship, they should get out in the industry more." Millennial 4 (translated from Afrikaans).

6.4.10 RESULTS FROM THE WINEMAKERS' INTERVIEWS SUMMARY

Geeks regularly interact with sources of factual knowledge, especially written material. They like to read, and it forms an integral part of their information-seeking processes. They even read scientific articles. They feel it is crucial for oenology research to be conducted in South Africa. They rarely interact with DVO oenology researchers and are generally unaware of their expertise or the research currently undertaken at the DVO. This is even though they indicated in the web survey that they are interested in the research results from the DVO. Geeks also obtain a significant amount of information from suppliers and their resources. They have preferred people to speak to at suppliers, whom they trust for their technical knowledge. They also consult with other winemakers for information, especially in the case of innovations.

Eschewers are interested in new products resulting from research, but not the process. Some of them have high admin loads that infringe on their information-seeking time. They don't like reading but will read if they need specific information to solve a problem or try something new. Mostly, they prefer to obtain information from people, suppliers and other winemakers at winemaker study and tasting group meetings.

According to the selected marketers, the answer to whether their sales and marketing responsibilities influence their winemaking information-seeking behaviours is, to some degree, yes. However, it is not negative for them since they have strategies to ensure that information still reaches their winemaking teams and sometimes them, albeit in a digested form.

Supplier supporters have preferred suppliers whom they will interact with for technical information. This finding is not different from what other winemaker groups indicated; the only difference is their higher frequency of use, which is why they were selected. Supporters place a high level of trust in specific individuals from these companies, in addition to the quality of products and the credibility of the companies. Two companies, in particular, seem very well respected for their technical expertise.

One person from one of these companies was singled out for his technical knowledge on a few occasions by various winemakers in the study and not just this grouping.

The interviewed millennials were very interested in new information but preferred to obtain this information from people. Although they do read, they seem to have less time than geeks (or are less willing to allocate time) and would instead phone someone for a solution because it can provide a quicker answer. Of all the groups, they tend to be the closest to oenology researchers. They know some of them and are willing to contact them if they have questions. They are not interested in the research process, only the practical results applicable to them. They have good trusting relationships with suppliers, their primary sources of innovation. Finally, an interesting observation made by three millennials is that they blame themselves for not being more active in information seeking.

"I am a bit lazy, not lazy to read, but I read quickly and move on. For me, seminars, events or presentations of certain topics tend to stick longer with me." Millennial 1 (translated from Afrikaans)

"I am too lazy to make more effort to gather information." Millennial 1 (translated from Afrikaans)

"It is 100% my fault that I don't read these things [Winetech Scan]. Very bad. Millennial 2 (translated from Afrikaans)

"Well, I am also a winemaker, and winemakers are lazy, and we only look for the answer." Millennial 3 (translated from Afrikaans)

"There is a lack of engagement from the industry's side. This can, unfortunately, only lie in front of the industry's door. We cannot blame the researchers for nobody being interested in reading their articles." Millennial 3 (translated from Afrikaans)

Suppliers of oenological products and services emerged as very important intermediaries in the SA wine industry, specifically for winemakers. In the first part of this chapter, results from the web survey indicated a high frequency of use for suppliers (people), supplier websites, emails and events (see tables 6.6, 6.7 and 6.8). These results were contrasted with suppliers and their resources on the lower end of the scale in terms of trustworthiness (see tables 6.9, 6.10 and 6.11). The interviews revealed that winemakers had preferred suppliers with a tremendous amount of social capital, more than DVO researchers. Suppliers' knowledge and other winemakers' knowledge are generally preferred over traditional resources containing scientific research results. It should be noted that the information obtained from suppliers and their resources can be based on scientific facts, practical results, and informed opinions.

The discrepancy between the frequency of use and trustworthiness of suppliers is because winemakers referred to all suppliers and their resources when they answered the question on trustworthiness, and not just those they frequently consult for information.

This concludes the section on the information-seeking behaviours of five winemaker typologies. Szymanski and Davis (2015) found considerable heterogeneity amongst the Washington winemakers regarding how they look for information. This study did not find such significant heterogeneity amongst South African winemakers. Talking to other winemakers and preferred suppliers seems to be common threads throughout all the typologies investigated. Social and experiential learning, sometimes with suppliers assisting with trials, emerged as the primary learning pathways for the community of winemakers. The only notable exception is the geeks who spend significant time studying written materials (factual learning) in addition to social and experiential learning.

6.5 THE INFORMATION-SEEKING BEHAVIOUR OF INTERMEDIARIES

This section provides the results of interviews with ten oenology intermediaries in the South African (SA) wine industry. These intermediaries were purposefully selected based on mentions by winemakers during their interviews, their formal education and experience, and their centrality in the winemaking knowledge network. Intermediaries act as boundary spanners between academia and practitioners. Their main role is to disseminate new knowledge in the network and, if they are suppliers of products or services, to promote the uptake and utilisation of new knowledge (Dippenaar, 2017). The interviews had three thematic foci:

- Where intermediaries obtain their information from,
- Intermediaries’ perceptions of, and experiences with, winemakers in terms of their information-seeking behaviours, and
- Intermediaries’ relationships with oenology research and DVO researchers.

The following section gives a brief background on the demographics of the intermediaries. After that, the three themes are addressed, followed by concluding remarks on the role of intermediaries in the SA wine industry.

6.5.1 DEMOGRAPHICS OF SELECTED INTERMEDIARIES

Eight of the ten selected intermediaries had post-graduate degrees in an oenology-related field. These degrees included one honours degree, five master's degrees and two PhDs. One of the two remaining intermediaries is a former winemaker who studied oenology at the Elsenburg Agricultural Training Institute. The other had an unrelated university bachelor's degree but had extensive experience in the SA wine industry as a service provider. Seven intermediaries worked for suppliers of oenological products, two were winemaking consultants, and one worked at a commercial laboratory that does oenological analyses.

6.5.2 INTERMEDIARIES' RESOURCE USE

As indicated by the results from the web survey and interviews, South African winemakers obtain most of their information from other winemakers, suppliers, and consultants in the industry. It was therefore of interest to investigate where these suppliers and consultants get their information from and if their resource use involves academic research results and other sources of factual knowledge. Table 6.19 summarises the sources of knowledge mentioned by the intermediaries.

The resource use of oenology intermediaries differs markedly from those of winemakers. The most notable differences are intermediaries' higher incidence of written resource utilisation and that most of them read scientific articles from time to time. The suppliers amongst the intermediaries indicated that they have access to experts and other extensive resources of their parent companies or the companies that supply some of their products. These companies are large international companies with considerable research and development divisions that sponsor academic research at various institutions worldwide. Most of the information the suppliers communicate to winemakers comes from these multinational companies since this information is about products and processes that winemakers use. The information communicated can comprise facts obtained through scientific research and practical information obtained through trials and usage by winemakers. Since winemakers are very interested in results obtained by other winemakers, it explains their frequent use of suppliers as sources of information.

Table 6.19: Resource use by South African oenology intermediaries

	Intermediaries									
	1	2	3	4	5	6	7	8	9	10
International parent company/supplier		+	+	+				+	+	+
Winetech Technical in *WineLand*		+	+	+		+	+	+	+	
*Winetech Scan**		+	+	+	+			+	+	+
Internet				+	+	+		+	+	
Scientific articles	+	+	+	+	+	+			+	+
Australian practitioner magazines	+				+	+			+	
AWRI				+						
Newsletters		+			+					
International experts							+			
Local experts	+					+	+			
Other supplier resources	+	+								
USA universities oenology department resources				+						

**Winetech Scan* data is supplemented with information from Winetech (to which the principal investigator of the study has access) on user email open rates as recorded by the email programme. The table includes intermediaries with an email open rate of more than 50%.

Most intermediaries read *Winetech Technical* articles in *WineLand* magazine and the *Winetech Scan* newsletter when the content is relevant to them regarding the products and services they provide.

Eight intermediaries mentioned that they read scientific articles on an ad hoc basis. Intermediary 6 admitted only “scanning” the *South Africa Journal of Enology and Viticulture*. None of these intermediaries has personal access to subscription journals. They either read articles in open access journals or have sources that can provide them with the paywall articles they require. Intermediary 3 mentioned that he sometimes obtains papers through ResearchGate. Only intermediaries 2,4,5 and 9 knew exactly what open access articles were, and Intermediary 9 indicated that since articles became open access, his frequency of reading scientific articles increased. Intermediary 4 felt that she would have read more if more articles were open access. The internet (Google search) is also frequently used as an information resource.

The reasons for the increased use of sources of scientifically validated information compared to winemakers were not explicitly explored. However, there can be three possible reasons:

- The selected intermediaries have a strong learning intent, which is probably why most have post-graduate degrees.

"Must be my nerd background. I am an objective reader and researcher. I read an awful lot." Intermediary 4 (translated from Afrikaans)

"I try to read scientific articles from the university or from {name of supplier} who sends us information. I read industry newsletters and watch other suppliers' websites and blogs to boost my general knowledge. I think it is important to know what is happening in the industry." Intermediary 2 (translated from Afrikaans)

"I don't think winemakers are bothered that much nowadays with a person's qualification, even though it is important. It gives you background and insight into how things work. I think in my case, I have always been curious about how things work. I think it [post-graduate degree] gave me the insight to understand why a product works better, and it enabled me to communicate on a more technical level with a winemaker, which allowed them to realise that I know what is going on in my product." Intermediary 3 (translated from Afrikaans)

- The selected intermediaries have a commercial interest in their clients and aim to offer a service that will help them gain new clients.

> *"If you go in and you can solve the problem, then you have a client forever."* Intermediary 2 (translated from Afrikaans)

- Some winemakers want the scientific explanation behind a product, process, problem or innovation. Suppliers and service providers that are very knowledgeable gain the winemaker's trust and can become one of their 'preferred suppliers.' Knowledge can therefore increase a supplier's social capital.

> *"You have some more technically inclined winemakers, and they ask more technical questions to understand how a specific product works. Then you have guys that only want a solution. Just give me the product."* Intermediary 3 (translated from Afrikaans)

> *"I believe you must build a relationship with your winemaker or client. A relationship is not something you can force on someone; with a relationship, I also mean trust. Many of the products are highly technical with different aspects to these products. So, if you can explain it to a winemaker so that he can understand it and how it will solve his problem, then there is a greater trusting relationship. And I think the more they trust*

you, the better is their problem solving compared to a random salesperson who just wants to sell a product." Intermediary 3 (translated from Afrikaans)

"They will want to know what the science behind it is and the chemistry." Intermediary 4 (translated from Afrikaans

6.5.3 INTERMEDIARIES' INTERACTIONS WITH WINEMAKERS

Intermediaries were asked when winemakers would typically contact them for advice. According to them, winemakers will mainly contact them when they encounter a problem, they need help solving. In some cases, it would be for advice on using a new product or winemaking technique, for preparing wine for bottling or acting as a sounding board for ideas.

6.5.3.1 Causes of winemakers' problems

In terms of the problems winemakers encounter, intermediaries felt that unforeseen circumstances could lead to problems in the cellar, but in most cases, the issues could have been prevented if winemakers had made better-informed decisions. According to intermediaries, the problem is not a shortage of available information but a lack of information uptake, a disregard for instructions given, taking 'short cuts' on protocols, and generally taking chances and hoping they will get away with it. The following quotes present some examples of situations intermediaries reported experiencing from time to time.

"Other times, it is simply ignorance. They did not listen good enough during training. There are many cases where the technology is misapplied, and the results are not what they could have been." Intermediary 1 (translated from Afrikaans)

"I think it is a question of ignorance and laziness. Discipline. You know, things take effort. You must want to do it. Things don't happen by themselves, and I think people often get away with some things, and at one stage, it is just too much and then 'problems develop'." Intermediary 2 (translated from Afrikaans)

"I have seen that winemakers cause their own problems, but they don't want to tell you. They pretend it is an act of God…and then you find out via the grapevine, or you look at the laboratory analysis, and you scratch a bit deeper and then see that the problem was there from the beginning. They knew they had a problem, and when it became bigger, they pretended they did not know about it. Now, if they really didn't know, I don't know, but you don't want to make them feel bad… but you must somehow tell them, it's obvious, you didn't add yeast nutrients or whatever." Intermediary 5 (translated from Afrikaans)

Intermediary 6 agrees that winemakers often cause their own problems. Sometimes they don't do the proper analysis at the correct times or wait until it is too late and then make the wrong decisions. In his opinion, some winemakers "lack a deeper understanding of what problems can occur in wine", especially younger, less experienced winemakers. Lack of experience is, however, not always the case; he also experiences a "laziness" amongst winemakers to adhere to basic principles in a cellar, like "making sure tanks are full". Finally, he also believes that winemakers don't stay up to date with the latest developments and don't give themselves time to gain new knowledge, which is the primary cause of their problems.

According to Intermediary 8, problems can also arise due to winemakers being financially under pressure.

"I think winemakers are becoming more financially constrained. So, they try to manage their chemical bills. Maybe they will use a cheaper brand and not so well-known, or they inoculate at a much lower dosage than what suppliers recommend. So, I think they try and cut corners and costs." Intermediary 8

Intermediary 10 agrees with this observation that winemakers "take shortcuts" and "not following procedures correctly" to save costs, leading them to a place where they experience problems in the cellar.

Intermediaries 7 and 9 felt winemakers' "lack of knowledge" contributes to problems in the cellar.

6.5.3.2 How winemakers react to the advice given to them by intermediaries

Intermediaries reported two ways winemakers respond to advice, whether to solve a problem or try something new. On the one hand, they will follow the advice given to the tee due to desperation to solve the issue. In other cases, they won't, for various reasons: they don't have the time, they either don't have or don't want to spend the money, or they don't want to follow the exact instructions because of different beliefs. Intermediary 7 has experienced that some winemakers have continued with a bottling process, against the advice given that the wine cannot be bottled, simply because they have made the booking with the bottling company and "cannot" back out now. They are willing to take the chance that nothing will go wrong. Intermediary 10 reported experiencing winemakers adjusting the given problem-solving protocol by substituting the recommended products with cheaper products.

6.5.3.3 Winemaker types

Intermediaries were asked to categorise winemakers in terms of their information-seeking behaviours. This was done to see if the Washington winemaker typologies as described by Szymanski and Davis (2015) or the SA grape grower typologies as described by Dippenaar (2017) were also applicable to SA winemakers. Szymanski and Davis (2015) categorised winemakers into four typologies: science-driven, vision-driven, utility-driven and pensive. Dippenaar (2017) categorised grape growers as bookworms, double-checkers and social animals.

The intermediaries of this study categorised winemakers based on how they responded to their advice. Three intermediaries categorised winemakers based on their personality types and not linked to any demographics.

Intermediary 1 categorised winemakers into "cowboys," "nerds", and "dilly-dallies." Cowboys are "actors, talk a lot and believe what comes out of their mouths". They are also "know-it-alls" and are arrogant". If a problem tends in their direction, they deflect it. Nerds are humble, interested and "hunger for knowledge". The dilly-dallies don't really care. They have lost interest and "only work to be able to play golf on a Wednesday and a Friday."

Intermediary 5 also categorised winemakers into three groups, with two of the groups described as "set in their ways." According to Intermediary 5, the one "set-in-their-ways" group doesn't know what is going on in wine research and the new technologies and local trends. They are uninformed because they are not interested to know and just continue to do things the way they have always done them. The other "set-in-their-ways" group is informed and is interested in new technologies but is still sticking to their way of doing things. The third group is informed and open to new knowledge and technologies and is willing to experiment.

Intermediary 7 categorised winemakers as those "being very serious in what they do" (pay attention to quality and follow the best, correct and latest recommended procedures) and those "who just follow the same protocol over and over" (recipe winemaking), as well as "those who are production driven and will take chances to deliver outputs and don't concentrate on the quality so much." The last group are usually not owners or entrepreneurs; they "work for someone and will take chances until they are caught out and then move on to another cellar."

Five intermediaries categorised winemakers according to age, with "older" winemakers being more inclined to be "set-in-their-ways" and less likely to take up new knowledge and trial new technologies. Younger winemakers are more eager to learn and open to new technologies and trials. This categorisation is a generalisation, and exceptions exist, evident from the empirical study of winemakers discussed in earlier sections of this chapter. It is also uncertain what intermediaries classify as "older." Four intermediaries who made this classification were in their forties and one in his fifties, so one can speculate that they probably refer to winemakers over 50, but that would be an assumption.

"Older winemakers are a little more set in their ways. These things have worked for me for many years, so I continue with them. Younger winemakers, with the approval of older, more established winemakers, and if the setup allows for it, are more open for experiments, for more trials." Intermediary 4 (translated from Afrikaans)

"A lot of the older winemakers have set recipes. You know, they have the opinion if it's not broken, don't fix it. I think the younger guys that are coming in, younger winemakers, are more tech-savvy and more willing to take risks and do trials and make their own mark on the wine. Intermediary 8

I think they [younger winemakers] are more open to, you know, reading the information, going online. The older guys aren't necessarily tech-savvy, and they are not really interested." Intermediary 8

Intermediary 8 did not think this "younger generation" would become like the current "older generation". They have a "very different generational mindset" and will "keep moving with the times."

"The older winemakers are, the more 'set in their ways' they are. Twenty years ago, I did things this way, and it worked. So why can't I still do things this way today? It still works. It is a very generalised point that I will make but convincing the older generation to take up and utilise new technology is tough. Younger winemakers are much more accommodating to new technology." Intermediary 9 (translated from Afrikaans)

"The younger generation of winemakers make wine with their phone if I can put it that way. They look at their phones to find stuff and use the internet. Whilst your traditional older winemaker made wine in a time when information was not that readily available. Maybe he does not feel that comfortable…maybe he feels I do what I do, and it works for me. So, I don't need to look for help in another place." Intermediary 10 (translated from Afrikaans)

Intermediary 8 felt there was a difference between winemakers working at estate wineries and those working at bigger, cooperative wineries. Those working at bigger wineries, which are more price-sensitive because of the large wine volume they produce, are slightly more restricted in implementing new technologies. He finds winemakers from estate wineries more willing to spend money to prevent problems or in terms of the products they buy.

6.5.4 INTERMEDIARIES' RELATIONSHIP WITH OENOLOGY RESEARCHERS AND THE DEPARTMENT OF VITICULTURE AND OENOLOGY

The intermediaries interviewed appear to have a closer relationship with the DVO oenology researchers interviewed as part of this dissertation's empirical study than South African winemakers. Six of the intermediaries indicated that the companies they work for or represent have previously funded contract research at the DVO and continue to do so on an ad hoc basis. They have also commercialised oenological products and services based on their collaborations with the DVO. Some of the intermediaries did express that their relationships with the DVO researchers were not necessarily as good as they would have liked them to be and that they experienced a lack of communication at times. They felt that this is unfortunate since they can help researchers identify and conduct projects more relevant to the industry due to their frequent contact with winemakers. Some of them also felt that the DVO researchers are not always aware of the realities of practical winemaking and should be exposed to the industry more. Projects can potentially have a better outcome if there is a closer relationship between researchers and industry.

"I think there is a massive disconnect between academics and maybe winemakers. I think the gap is big."

"A person just wants some feedback. In the past, we have often tried to figure out what is going on or how things are progressing, and then there is very little feedback. So, it is always a bit of a red light for me. And then, another thing is that in the past our advice was not followed to the letter. So, I have a question mark to that as well because, in the end, we are linked to a project, but we know it was not done 100% correctly. "Intermediary 2 (translated from Afrikaans)

Intermediary 2 attributes the reasons for the disconnect and lack of communication as a researcher's "personality thing" that results in them not always being open to listening. She further describes the researchers as being in an "institutional bubble" and a "huge comfort zone for some reason."

Intermediary 3 felt there is value in researchers interacting with suppliers due to their commercial experience. It can allow researchers to understand better which problems exist in the industry and why they are not solved yet. Intermediary 9 agreed with this and indicated that suppliers' tie-strength (frequency of communication) with winemakers makes them more aware of winemaker problems and needs.

"Since my time [as a researcher in the DVO], I have always believed there is a disconnect between researchers and what is happening in the industry. There must be someone that can stand in the middle that can take the industry's hand and the hand of academia and bring them together, almost as a processor that can convert highly academic information into something more digestible for the industry." Intermediary 3 (translated from Afrikaans)

"I think the benefit for research institutions to contact us is because of our regular interaction with the wine industry on a personal level, one on one with winemakers, wine cellars, wine groups, that we know what many of their problems and needs are. In many cases, we can maybe communicate this information to research institutes by saying rather focus your research more in this direction, because we are getting many enquiries to address this problem or to improve on this technique or something of the sorts." Intermediary 9 translated from Afrikaans)

Intermediary 4 commented that the projects funded by Winetech of late have improved in terms of industry relevance and ascribed that to Winetech that started to require researchers to speak to the industry about their research ideas before submitting their research proposals to them.

Intermediary 5 felt that DVO researchers are "out of touch" with industry, and she felt that one of the ways to address this is to allow more intermediaries and winemakers on Winetech committees that evaluate oenology projects for funding. Another way is to organise workshops where researchers and winemakers share factual and practical knowledge. This workshop should ideally be organised by an intermediary (and not academics) who can select the relevant topics and speakers.

In contrast, Intermediary 6 felt it would be challenging to find winemakers to serve on Winetech committees since they are very busy and suggested direct contact would probably be better. He also had the experience where he provided input into a research project, and then the researcher did not follow his advice, which he deemed attributable to a "lack of knowledge" of what is relevant to the industry.

Intermediary 6 felt that there is value in winemakers and the DVO to have a "reciprocal kind of relationship" and that Winetech as an intermediary, has a vital role in this relationship. In addition, they, as a supplier, also want to add value to the knowledge network in the industry.

"I don't think the relationship between …you know…the winemakers specifically with the department, and that is why the intermediary like Winetech is super important, and that is the bridge. But directly with them [the DVO and winemakers]? No, via Winetech, yes."

"Obviously, we are a supplier, and it is a business, so we would always want a return on our investment. But besides that, we are here in the industry and want to add value. We want to have a relationship with all the players in the market. It would be very short-sighted not to have…you know…a full circle of everybody working together. So definitely, it is super important to have that openness and willingness to all work together." Intermediary 6

Intermediary 10 agrees that there is some distance between DVO researchers and winemakers. He attributes it to winemakers' perceptions that what happens in the department is only academic with very little practical application. He also felt that winemakers want information but don't necessarily want to be involved in the research process. He added that at one point, the sensory department of the DVO involved winemakers in academic projects, which was a good way to get industry input.

6.5.5 RESULTS FROM THE INTERMEDIARIES' INTERVIEWS SUMMARY

The information-seeking behaviours of the selected intermediaries differed substantially from those of winemakers. They were more focused than winemakers on obtaining factual (scientific) and practical information, including information from written resources. They have a strong learning intent and are both intrinsically (desire to help) and extrinsically (commercial interest) motivated to obtain as much knowledge as possible.

Intermediaries experience winemakers falling into different groups regarding their information-seeking behaviours, with some winemakers (a minority) being described as lazy, disinterested and uninformed. They believe many winemakers' problems are self-inflicted and could have been prevented if they had followed instructions or were better informed. They believe there are enough information resources in the industry to provide winemakers with all the information they need.

Intermediaries have a closer relationship with the DVO and scientific research in general. They see themselves as necessary in translating scientific research results into more digestible forms and practical applications for winemakers. They also feel that winemakers are a significant source of knowledge for them because of their useful knowledge exchanges.

CHAPTER 7: DISCUSSION AND CONCLUSIONS

7.1 INTRODUCTION

One of the intended outcomes of scientific research is for industries to be able to use the new knowledge generated (Rajaeian, Cater-Steel & Lane, 2018) and thereby ensuring their economic well-being, growth and future sustainability. Governments consider strong university-industry collaborations as a critical factor in economic development. As a result, programmes and policies to promote academic-generated knowledge have become widespread in many countries, including South Africa.

As discussed in chapter 1, Caplan (1979) conceptualised (university) researchers and (industry) users as operating as two separate communities with different values, languages and rewards. These differences can create a “knowledge gap” between them, and for effective knowledge transfer to happen over this gap, boundary-spanning activities need to happen. These activities can happen with or without the help of intermediaries, which can be people or organisations. When engaging with each other, it is also essential for the two communities to understand and respect each other’s values, languages and rewards.

This chapter contains the discussions of the results from the empirical components of the study as presented in Chapters 5 and 6. It concludes by discussing the value of the boundary spanning activities identified in Chapter 1. Finally, recommendations are made for the DVO, Winetech and winemakers to consider as well as suggestions for future research.

7.2 THE INDUSTRY ENGAGEMENT AND KNOWLEDGE TRANSFER ACTIVITIES OF OENOLOGY RESEARCHERS

7.2.1 RESEARCH SUGGESTED BY PREVIOUS STUDIES

Perkmann et al. (2021), in their most recent review of the academic engagement literature, identified various areas that require future research. The results of the empirical study involving the researcher community, as presented in Chapter 5, will partly be discussed as it addresses some of the identified research needs in the Perkmann et al. (2021) review. It is important to note that the results also include the motivations of individual researchers to engage with industry (Franco & Haase, 2015; Iorio, Labory & Rentocchini, 2017). "Motivations" was initially listed in the earlier Perkmann et al. review as a research need (Perkmann et al., 2013).

The Perkmann et al. (2021) framework served as a backbone and was built upon by adding "motivations (intrinsic and extrinsic) of individual researchers" under the "individual characteristics" category. An additional category was created: Research funding expectations, which emerged as an important determinant of researchers' engagement with the South African wine industry. See Figure 5.1 for the adapted academic engagement framework that guided this study. Results are discussed according to this framework of factors that can influence the industry engagement and knowledge transfer activities of oenology researchers.

7.2.2 INSTITUTIONAL FACTORS

Perkmann et al. (2013, 2021) use the term "institutional" for discipline/field and national policies and organisational to describe university-related factors that can influence academic engagement. The scientific literature on knowledge production and transfer involving academic researchers spans many research fields, with definitions and terminologies that are not always standardised, thus making cross-comparisons between studies challenging. Two terminologies that can confuse are "knowledge transfer" and "institutional". In this dissertation, knowledge transfer meant a unidirectional transfer from one entity to another, as well as the *exchange* of knowledge between two entities, e.g., researchers and industry. "Institutional" can mean "organisational" in some studies, e.g., the university where researchers work, or it can mean research field/discipline and national policies. The term "organisational" has been used in this dissertation mainly when referring to the university environment to limit possible confusion.

7.2.2.1 Discipline

The scientific field or specific discipline is a significant variable determining university-industry engagement (Perkmann et al., 2021). Applied sciences such as engineering, agronomy and various life sciences are considered closer to an application than physics and mathematics (Giuliani et al., 2010). On the other hand, natural sciences, in general, can involve a significant amount of fundamental and strategic research that is more inclined to result in explanations or discoveries rather than a direct end-user application (Becher, 1994). Scientific disciplines viewed as applied sciences are generally more likely to facilitate university-industry collaborations (Giuliani et al., 2010).

There can be exceptions to the rule, and it has been reported in literature that individuals within disciplines, whether they are considered basic or applied fields, can have different research orientations (Perkmann et al., 2021). The literature also reports that researchers who do basic research tend to engage less with industry than researchers conducting or viewing their research as use-inspired basic or applied research. It can be argued that the latter group of researchers are more motivated to address issues of near-to-market research applications (Hughes et al., 2016).

Disciplinary science also spans international boundaries, which can influence the research type within a specific scientific community (Bentley, Gulbrandsen & Kyvik, 2015). The discipline can also affect knowledge transfer channels between university and industry (Bekkers & Bodas Freitas, 2008).

This empirical study focused on oenology researchers. Oenology is considered an applied science as it entails the study of wine and winemaking from an agricultural crop, i.e., wine grapes. The Department of Viticulture and Oenology falls under the Faculty of AgriSciences (agricultural sciences) at Stellenbosch University, South Africa.

The results from the interviews revealed that most of the participants saw their oenology research as applied. This is in line with the study of Bentley et al. (2015), who found that agricultural and engineering researchers considered their work predominantly applied. However, three participants in the current study indicated that sometimes what they view as applied can be different to what the SA wine industry views as applied. Researchers tend to think of the benefits of projects in the long term, whereas the industry often wants applicability in the short term. This finding is supported by a survey conducted amongst Danish researchers who identified “conflicting time frames in industry and academia” as a barrier to engaging with non-academic actors (Kongsted et al., 2017).

An interesting finding from participants describing their research is that the study of wine, to a large extent, entails the principles of natural science disciplines such as chemistry, biochemistry, biotechnology, microbiology, etc. Most post-graduate students at SAGWRI come from the university’s natural sciences faculty or from a similar faculty at other universities. Very few are viticulture and oenology undergraduates. The reason given by one of the participants is that natural science training prepares the students better for the type of research they do at SAGWRI. Another reason a different participant gave is that viticulture and oenology students are not very interested in post-graduate study, and very few students apply each year. To deliver on the university’s expectation of academic excellence, SAGWRI researchers must also recruit students from the natural sciences. Most of the post-graduate students of SAGWRI, and the IWBT over the years, also do not end up working in the wine industry.

The participants themselves have either agricultural or natural science backgrounds. Those with agricultural backgrounds indicated that because they come from this background, they are inclined to continue this path of "pragmatic" research relevant to the industry. They also indicated that they regularly interact with industry, which can be winemakers and industry funders.

Most of the participants, originally IWBT researchers, come from natural science backgrounds. Three of them indicated that since natural science is their foundation, they prefer to stick to what they do best, which is fundamental research. However, the way they described their research, a better classification would be strategic (Rip, 2002) or use-inspired research (Stokes, 1997) since it still has possible future applications. One of the researchers, despite her preference for fundamental research, indicated that she regularly does knowledge transfer to industry, even about projects not funded by industry. This finding demonstrates how the individual preferences of a researcher can override disciplinary and research orientation factors. This finding is also supported by the study of De Fuentis and Dutrénit (2012) of Mexican researchers, where those engaged in basic research and technology development interacted more with industry than those doing applied research.

A previous report based on semi-structured interviews conducted with some of the same researchers in the DVO with regards to their knowledge transfer activities revealed participants' concern that the industry does not appreciate the need for fundamental research and the importance of maintaining academic status and credibility of the researchers at the DVO as a whole (Joubert, 2018). In the current empirical study, this sentiment did not come across so strongly. Most participants indicated that they find a balance between excellence (the university's expectations) and relevance (the industry funders' expectations). They design their projects in such a way that they have academic novelty, quality, and industry relevance. They indicated that should industry funding stop, their focus will shift to fundamental research only, as the discipline of oenology allows for this, accompanied by less industry engagement and knowledge transfer. The DVO's contribution to the South African wine industry will then predominantly be undergraduate training of viticulture and oenology students that can become viticulturists and winemakers, which one can argue, is the single most significant contribution of the DVO in terms of knowledge transfer to the SA wine industry, anyway.

7.2.2.2 Policy and regulation

Studies on the influence of national policies and laws on academic engagement focus mostly on North America and Europe, with limited studies from other geographical areas (Perkmann et al., 2021). There is a need for studies in middle-income and developing economies and the influence of this context on academic engagement. South Africa falls within the latter categories but presents an interesting case study because of its high-quality science system compared to other developing economies. According to the Times Higher Education rankings ("World University Rankings 2022 | Times Higher Education (THE)", n.d.) South Africa has three universities falling in the top 300 universities in the world category. That includes Stellenbosch University, the university the participants in this study are affiliated with.

National policies affect how public universities are funded (Perkmann et al., 2013). In South Africa, universities receive funds from various governmental organisations, as discussed in chapter 3. The research outputs subsidy of the Department of Higher Education and Training (DHET) is a significant source of income for public universities, if not the primary income source ("Research Outputs Policy", 2015). The DHET grants a subsidy for each scientific publication by a South African author or co-authors listed in one of their three accredited journal lists (WOS[30], DHET and IBSS[31])(Mouton & Valentine, 2017). The subsidy does not distinguish between journals for any reason (e.g., local versus international or impact factor). It also favours quantity over quality.

Three participants in this study specifically mentioned the research outputs subsidy and how it influences Stellenbosch University's evaluation system, which, in turn, affects researcher industry engagement. The subsidy system feeds the publish or perish culture of academia because for SA universities to generate an income, their researchers need to publish as much as possible. This differs from many developed nations' government funding systems for universities, where funding is allocated according to input-orientated measures (Bentley, Gulbrandsen & Kyvik, 2015).

Several other national factors of a socio-economical nature can influence South African researchers in general, as identified by Joubert in her study of publicly visible scientists in South Africa (Joubert, 2017). Probably the most relevant to the participants in this study is the Department of Science and Innovation's Science Engagement Strategy, which has four strategic aims, with one being "to promote science communication that will enhance science engagement in South Africa" (Department of Science and Innovation, 2015). The DSI plans to address this aim through various interventions, including incentives for researchers to communicate their work and target higher education institutions. At the time of writing, the oenology researchers have not received any "incentives to communicate their work" on an individual level. However, national higher education policy has encouraged universities to be more socially responsive and promote community engagement, especially with marginalised communities (Kruss & Visser, 2017). Stellenbosch University has

[30] Clarivate Web of Science

[31] International Bibliography of the Social Sciences

established a whole division for social impact that will be discussed in the next section relating to organisational context/factors influencing academic engagement.

7.2.3 ORGANISATIONAL FACTORS

7.2.3.1 Formal incentives

"… while engagement in knowledge transfer activities has become a Mode 2 expectation for university-based researchers, many academic units continue to operate under historical (Mode 1) conditions that emphasize the primacy of disciplinary authority. The importance of knowledge transfer may be endorsed in rhetoric, but rewards and resources (and thus priorities) reflect the enduring value accorded to more traditional academic activities."
(Jacobson, Butterill & Goering, 2004, page 251)

Scientific literature focusing on the effect of incentive systems and university support on academic engagement is very scarce (Perkmann et al., 2021). In addition, the literature that does refer to knowledge transfer enablers and barriers, which include formal incentives, mainly relates to technology transfer and innovation, i.e., commercialisation. The science communication literature contains more evidence of the influence of evaluation systems and incentives on researchers' willingness to communicate with non-academic audiences. However, this literature usually focuses on the wider public or is not focused on specific practitioners per se. This presents a gap in the scientific literature and potential for future research, as identified by Perkmann et al. (2021) in their most recent review of academic engagement literature. The current study addresses this gap.

University missions, policies, incentive schemes and reward systems can directly influence researchers' willingness to engage in knowledge-related interactions with industry (Joubert, 2017). Researchers engage more frequently with the public if it is considered part of their job and is recognised and supported by their organisations (Searle, 2011). However, university evaluation systems for promotion and tenure are frequently listed as barriers to knowledge transfer (Jacobson, Butterill & Goering, 2004). In general, academia's evaluation system values traditional academic activities such as publication in peer-reviewed journals, presentations at disciplinary conferences and the reception of public grants as more valuable than knowledge transfer to non-academic audiences.

A barrier linked to evaluation systems is a lack of time. There is only so much time in a day, and researchers tend to focus on those activities that determine their position within academia's promotional system. The result is that knowledge transfer, if not adequately recognised and incentivised, becomes low on the priority scales of researchers.

All eleven researchers interviewed in the current study confirmed that Stellenbosch University strongly emphasises traditional academic outputs. There is an expectation for a certain number of scientific articles published yearly for their annual evaluation. The most frequently mentioned number during the interviews was two articles per year. Tied in with the publication expectation is an expectation of the graduation of post-graduate students. According to participants, teaching is not recognised to the same degree as publications and graduated students in the university's evaluation system.

Publications and the number of doctorate degrees awarded are two crucial criteria in the global university ranking evaluations (Methodology for overall and subject rankings for the Times Higher Education world university rankings 2021, 2020). Stellenbosch University is a research-intensive university and is under the top 300 in the world, according to Times Higher Education. It, therefore, has a reputation to uphold, leading to its strong emphasis on traditional academic outputs.

In addition, locally, the university's economic well-being is linked to traditional academic outputs because of the South African government's subsidy system, which incentivises publications and students who graduate (Research Outputs Policy, 2015). This subsidy is the primary source of income for the university (*Stellenbosch University Annual Integrated Report*, 2019). Whether presenting at industry seminars or writing plain language articles for industry, industry engagement generates no subsidy income for the university. Various researchers in the current study felt the subsidy system (a national factor) is the main driver for the university's different researcher evaluation systems (annual and promotion).

Adding to SU's evaluation criteria is the requirement for researchers to be rated by the National Research Foundation (NRF). These ratings are also strongly biased towards traditional scientific outputs, further promoting the pressure to publish on researchers, including the participants in this study. The participants expressed different feelings about being rated. Some saw it as a box-ticking exercise – they do it because the university requires it. Others saw it as a way to measure their academic standing amongst peers. Table 7.1 demonstrates the Faculty of AgriSciences, SU's specific requirements for appointments and promotions regarding degrees and an NRF rating. Take note these are not the only requirements.

Table 7.1: Recommendations for appointments and promotions of academic staff at the Faculty of AgriSciences, Stellenbosch University

Position	Degree requirement	NRF rating requirement
Junior lecturer	Master's degree or equivalent	No
Lecturer / Researcher	PhD (In exceptional cases, a master's degree or equivalent and registration for a PhD degree will be accepted.)	No
Senior Lecturer / Chief researcher	PhD	Strongly advised
Associate professor / Principal researcher	PhD	Required
Professor / Research Professor	PhD	Required

Source: Faculty of AgriSciences, Stellenbosch University

Researchers find themselves in a disjunction. To keep and further their careers, they must abide by the university's expectations of knowledge creation and its outputs (publications and graduates) and knowledge sharing (undergraduate teaching) and meet the knowledge transfer requirements of their funders. In terms of research, one can only do research if you have funding for it. Public funding, especially in developing countries, is insufficient to allow universities to become and remain world-class. Augmentation with third stream funding is necessary, but it comes with strings attached – conducting research with application in mind and the expectation of knowledge transfer. Researchers must therefore manage their time between meeting the requirements of both their employer and their funder, which requires a skilled balancing act. Most of the oenology researchers in the study indicated that they could design research projects that meet the requirements of both excellence and relevance. However, the lack of formal recognition and organisational support is a constraint for KT activities. On the other hand, it seems reasonable for a university to emphasise traditional academic outputs if it enhances its global reputation and rankings and generates an income for it.

Participants of the earlier non-academic study of knowledge transfer and science communication in the South African wine industry by Joubert (2018) also highlighted the lack of organisational incentives and time constraints as barriers to industry engagement. The participants reiterated that industry engagement does not help academics get promoted, improve their NRF ratings, or bring any subsidy to the university. However, participants did feel that universities should recognise the broader role and impact of academics.

Data from the current study is supported by a survey by Rajaeian et al. (2018) among researchers in the IT outsourcing field that also found inadequate reward systems in academic settings as a barrier to knowledge transfer to industry. Another study amongst social scientists from various Australian universities and their engagement experience with government partners, industry and other research end-users supports the current study's findings (Cherney et al., 2012). In this Australian study, the participants were asked what barriers they encountered in transferring their research results to non-academic audiences, indicated by their level of agreement with certain statements. The number one barrier, as shown by 84% of the respondents, was the inadequate recognition by academic reward systems for research dissemination to non-academic audiences. The second most significant barrier, as indicated by 73% of the participants, was the academic requirement of publishing primarily in scientific journals. Participants felt that career enhancement depended on scientific publication and not practitioner interaction and that many researchers were dissuaded from participating in research partnerships with the industry. In contrast with the Australian study, only 27% of Danish researchers found universities not sufficiently prioritising and rewarding KT activities as barriers to engagement (Kongsted et al., 2017). They listed conflicting goals (41%) and time frames between academia and industry (33%) as more significant barriers to engagement.

The views of the current and previous SA wine industry study participants also support those of publicly visible scientists in SA (within the same national setting and similar organisational settings), who also perceived a lack of organisational support and backing for public science communication (Joubert, 2017). Visible scientists did, however, mention that a gradual shift in organisational culture to support public science communication was happening and mentioned the rewards systems of the University of Cape Town (UCT) and the University of the Witwatersrand, two other high-ranking South African universities.

The 1997 South African white paper on the transformation of higher education[32] acknowledges community engagement as a core activity in higher education. The paper requests South African universities are socially responsible and make their knowledge available to the broader public.

In the current study, participants mentioned the social impact strategy of Stellenbosch University. However, amongst the 11 participants, there were various views of this social impact strategy. According to the university's website and the Social Impact Strategic Plan, it seems that the plan mainly refers to specific initiatives or thematic programmes within society, and it is unclear on the ad hoc knowledge transfer and engagement initiatives of individual researchers ("Stellenbosch University

[32] https://www.justice.gov.za/commissions/feeshet/docs/1997-WhitePaper-HE-Tranformation.pdf

Social impact strategic plan 2017-2022", 2016). According to Gascoigne and Metcalf (2016), if a social impact policy is unclear, it can negatively influence researchers' willingness to spend time on external communication. The SU Social Impact Strategic Plan does acknowledge that an area that has not been developed fully by the university is how to measure and evaluate social impact successfully.

In both the current study and the 2018 study by Joubert, the researchers emphasised the freedom of choice to have industry engagement as an evaluative criterion in a researcher's performance evaluations. According to the participants, the reason is that not all people are natural communicators, and that industry also has preferences from who they want to hear. Studies in the science communication literature confirm the view of the participants in the South African wine industry studies that researchers should have autonomy in their choice of public engagement, as well as whether they should be formally evaluated on their engagement actions (Joubert, 2017). A potential negative consequence of making public communication evaluation a mandatory criterion in evaluation systems is that researchers might start to engage for the wrong reasons, namely for "box-ticking" to be incentivised by their institutions (Watermeyer, 2014; Burchell, 2015).

In conclusion, one can argue that not properly recognising and incentivising ad hoc researcher industry engagement can be short-sighted on the university's part since the frequency of communication between the university and industry (tie strength) can improve social capital and trust. This can potentially lead to increased industry funding and thus more research projects, students and publications, for which the university gets subsidies.

7.2.3.2 Organisational support

According to Jacobson et al. (2004), three factors influencing researchers' knowledge transfer (KT) behaviours relate to the level of organisational support. They are KT training, dedicated funding for KT activities and administrative support. All three of these factors were mentioned by the participants in the current study as constraints to their KT activities.

In terms of KT training, none of the oenology researchers interviewed received any KT training from the university or elsewhere. They reported being aware of communication training provided by the university via the Postgraduate Office and the Language Centre. They reiterated that the focus is only on scientific (academic) communication, i.e., thesis writing, scientific article writing, presentations for disciplinary conferences and undergraduate teaching. Only two participants mentioned a short course offered by CREST (Centre for Research on Evaluation, Science and Technology) that focuses on science communication, meaning researchers communicating with non-academic audiences. According to

CREST's website, it is an online six-week course with practical guidelines for science communicators offered in the sixth week[33].

It is unclear if any shorter time frame (e.g., one or two days) courses are offered by Stellenbosch University. Such an investigation fell outside the scope of the current study. If there are, participants were not aware of them. It could be that such training forms part of the curriculum of specific departments and that they are offered in-house only.

Joubert (2018) reported in the earlier DVO investigation that participants acknowledged a general lack of plain language writing and presentation skills, especially in the case of early-career scientists. According to the participants, the university only trains them in scientific writing and presentation. They are not trained to present to the industry or how to simplify without compromising the science. Joubert's investigation also found that the participants were keen to develop their science engagement skills with industry, other funders, policymakers and the general public.

An interesting finding from her study was the sentiment from the participants that researchers engaging primarily in basic research must also be equipped with critical/strategic communication skills because they need to be able to make a case for the value of their work.

In the current study, one participant mentioned a lack of confidence because of a lack of training as a constraint to her KT activities.

Literature on the effect of organisational training on researchers' knowledge transfer and engagement activities involving industry audiences is largely lacking. Science communication literature regarding training and public outreach exists (Joubert, 2018) but is too generalised to compare the current study. One can argue that the objectives for communicating with the general public and specific industries are slightly different. The main purpose of creating an informed society is the same, but in the case of communicating with particular industries, the objective to enhance collaboration in knowledge creation, thereby improving the economic well-being of both university and industry, carries additional weight.

The scientific literature on organisational support concerning funding is centred mainly around technology transfer offices and support systems, i.e., commercialisation. The participants in the current study were unaware of a specific fund, either within the DVO or Stellenbosch University, that they could tap into to fund their (non-commercial) KT activities, for instance, the funding of industry seminars. One participant mentioned using excess funds from his research budget built up over the

[33] https://www0.sun.ac.za/scicom/course/

years. Usually, the industry pays for the workshops and short courses, but some input cost is required before the industry registers for the days or courses.

During the existence of the Institute for Grape and Wine Sciences within the DVO, which was industry-funded, a dedicated and generous budget for KT activities did exist. With the help of two extension officers, various KT endeavours were funded (books, facts sheets, booklets, a website, email communication, social media, industry seminars, wine tastings, etc.). All this, however, came to an abrupt halt when funding ceased. This function is now performed mainly by an intermediary organisation, Winetech, the primary industry funder of vine and wine research. The potential downside of intermediaries handling most of the academic KT is that the role of the researcher as the primary expert can be diminished (Joubert, 2017).

As with training and funding, the DVO and the university lack dedicated administrative support for KT activities.

The organisational factors that influence the KT behaviours of the participants of this study confirm earlier findings by Kruss and Visser (2017) in their research of university-industry interaction in South Africa, thus the same national setting. The authors report survey results from 2159 academics from five universities in South Africa. These academics identified two barriers to industry interaction: academic identity and lack of organisational support. Academic identity refers to KT engagement activities not being central to their roles or not appropriate in their academic fields. The lack of organisational support for KT mentioned by the academics included factors in the current study: the lack of clear policy, administration support and financial resources and the recognition of KT as scholarship. The authors also found that academics at universities with stronger reputations for research (such as Stellenbosch University) viewed academic identity as a significant barrier to industry engagement.

7.2.4 FUNDER EXPECTATIONS

Funder expectations crosscut institutional, organisational and individual factors. The funder's expectations can influence the orientation of the research project, steering it into an "applied" direction (disciplinary factor), it can have an influence on researchers' output and performance evaluations (organisational factor) and affect researchers' extrinsic motivations, i.e., interaction to obtain research funding.

According to Czarnitzki, Grimpe and Toole (2015), public and private funding relationships with universities are fundamentally different. Industries can impose additional requirements on academic researchers, which was the case for this study.

All the oenology researchers who received funding from the National Research Foundation NRF (the main public funder of research at SA universities) at the time of the interviews or in the past mentioned that the NRF does not require societal relevance to the extent that Winetech, the main industry funder, does. One must indicate societal relevance as part of the NRF project application, and science communication is an expectation, but it is not strongly enforced. The NRF is more willing to fund basic and use-inspired basic research than industry funders. According to the participants, this leads to a lower propensity to engage with industry.

Some participants indicated that they only engage with industry because it is required when receiving industry funding. If the industry did not fund them, they probably would not engage with the industry, or they will probably engage much less.

It was found that those participants who did receive Winetech funding at the time of the interviews were more likely to engage and do KT to the wine industry than those who received public funding. These results are supported by a study by Bozeman and Gaughan (2007), who investigated the impacts of research grants and contracts on 1564 American academic researchers' industrial involvement. They found that researchers with industry contracts engaged with industry to a greater degree than those who are exclusively government-funded.

7.2.5 INDIVIDUAL CHARACTERISTICS

Studies in the academic engagement literature on the influence of individual characteristics on researchers' propensity to engage with industry concentrate mainly on easily measurable demographics such as age, gender, academic status, etc. Little attention has been given to researchers' personalities, motivations, perceptions and beliefs. To fill the gap in the academic engagement literature, it was decided to make researchers' motivations to engage with industry the focus of the current study. Perkmann et al. (2013, 2021) have also identified it as a research need.

Researchers' willingness to engage with industry can be influenced by different motivations and rewards (Iorio, Labory & Rentocchini, 2017; Joubert, 2017). Rewards can be intrinsic or extrinsic. Intrinsic motivations and rewards include enjoying industry interaction, feelings of satisfaction that one helped society, a boost in one's self-esteem because one is respected as knowledgeable and helpful, and a sense of duty and desire to fulfil the university's third mission of contributing to society's well-being. The desire to fulfil the university's third mission is also referred to as exhibiting pro-social behaviour (Iorio, Labory & Rentocchini, 2017).

Extrinsic motivations refer to tangible benefits and rewards such as money for research, money for doing KT (e.g., consultancy), improving one's reputation, and promotion. Researchers are also motivated to engage with industry to obtain research ideas and to learn. This learning intent can be classified as either intrinsic or extrinsic depending on the motivation behind the learning intent. It can be viewed as 'intrinsic' if the learning intention is to feel more knowledgeable and competent. It can be considered 'extrinsic' if the learning intention is to obtain good quality scientific publications and many citations.

The various motivations that drive oenology researchers to do KT and engage with the South African wine industry, and winemakers, in particular, are discussed in the following section. It is followed by a discussion of the constraints on KT activities experienced or perceived by the oenology researchers.

7.2.5.1 Intrinsic motivations of oenology researchers

Researchers in the current study indicated that they engage with industry firstly through contract research (engagement with Winetech research evaluation committees or R&D personnel of suppliers of oenological products). Secondly, they engage with winemakers on an ad hoc basis in various ways, i.e., to get input on research proposals (Winetech requirement), when requesting grapes, juice or wine samples for research purposes, winemaking problem solving, winemaker study group interactions and participation in industry workshops. These first two groups of interactions are dialogical/interactive. Thirdly, participants indicated that they do unidirectional KT through presenting at industry conferences and seminars and publishing plain language articles in practitioner publications. Only one researcher admitted to using social media as a KT channel. None of the participants consulted for industry and, in doing so, augmented their income, and none engaged in collaborative (joint) research in the true sense of the definition – original research work undertaken by academic and non-academic stakeholders (Kongsted et al., 2017).

The knowledge-related interactions mentioned by the current study participants include the interactions mentioned by Perkmann et al. (2013, 2021) but add to the academic engagement literature by describing the "informal activities such as providing ad hoc advice and networking with practitioners" in more detail.

The oenology researchers were asked what their motivations were for engaging with the industry. Interestingly, most participants' first response was enjoyment when engaging with winemakers. Studies on researchers' intrinsic motivations to engage with industry in the academic engagement and knowledge transfer literature are scarce, especially the reason to engage because they find it enjoyable. However, Joubert (2017) lists various studies from the science communication literature where researchers report that they find communicating science to the public a pleasurable and rewarding experience.

Researchers can also experience satisfaction just knowing that they have advanced the overall body of knowledge of their discipline and that the knowledge is helpful for society at large (Iorio, Labory & Rentocchini, 2017). Researchers with altruistic motivations can generally be expected to be more concerned with the impact of their research beyond academia.

Iorio et al. (2017) found that pro-social motivations (promoting the university's third mission) positively affected the KT activities of Italian scientists. A survey by Hughes et al. (2016) revealed that many UK academics viewed university outreach as an essential activity. Data from the current study support these findings in that participants expressed their desire to help the industry through contract research that addresses its specific challenges and problems. In addition, various participants saw it as their duty as academics at a university to help society.

One participant mentioned that engaging in knowledge transfer activities with the industry has improved her communications skills, leading to personal development. These intrinsic rewards derived from engaging with non-academic audiences have also been reported by researchers in the science communication literature (Joubert, 2017).

Interestingly, in most cases, participants in the current study spontaneously mentioned their intrinsic motivations before their extrinsic motivations.

7.2.5.2 Extrinsic motivations of oenology researchers

Although the researchers did not voice explicitly that they engage with industry to obtain funding for research, one can assume that it is the case, based on their responses where they admitted they would probably engage much less, or not at all, if they had adequate public funding. This finding is supported by studies conducted in Italy and Spain that obtaining research funding is the primary motivation for those countries' researchers to engage with industries (Tartari & Breschi, 2012; Ramos-Vielba, Sánchez-Barrioluengo & Woolley, 2016; Iorio, Labory & Rentocchini, 2017). Monetary incentives, especially those related to commercialisation, have also been shown to motivate KT activities of researchers (Landry, Amara & Ouimet, 2007; D'Este & Perkmann, 2011).

Several participants mentioned that industry interaction stimulates research ideas and provides them with learning opportunities and information that allow them to publish articles. Gaining new insight into their research is one of UK and Danish researchers' most frequently listed motivations to engage with non-academic audiences (Hughes et al., 2016; Kongsted et al., 2017). D'Este and Perkmann (2011), in their study of UK engineering and physical scientists, found that most scientists engage with industry to obtain funding and to learn, with the primary purpose of furthering their research. Various earlier studies also support funding and learning/feedback on research as primary extrinsic motivations for industry engagement (Katz & Martin, 1997; Lee, 2000; Bozeman & Corley, 2004).

According to Hughes et al. (2016), in their study of 18177 UK scientists, 49% indicated that they engage with industry to gain access to knowledge that will improve their teaching. Similar results were found in the survey of 4832 Danish scientists by Kongsted et al. (2017), with 46% of respondents indicating that insights gained from non-academic contacts can be used in teaching. This aspect was not spontaneously mentioned or purposefully explored in the current study.

Other extrinsic motivations/rewards reported in studies include researchers engaging with industry to ensure possible careers outside academia, augment their incomes or obtain access to state-of-the-art techniques and up-to-date equipment (Franco & Haase, 2015; Hughes et al., 2016; Kongsted et al., 2017). The participants in the current study did not mention these factors.

7.2.5.3 Perceived constraints to industry engagement and knowledge transfer

Discipline, research orientation and organisational factors (incentives, training, support) perceived or experienced by participants as constraints to industry engagement and KT activities have already been discussed in previous sections. This section deals with constraints experienced by the participants for academic engagement on an individual level.

Participants in the current study listed the following individual constraints to KT activities:

- Not a researcher long enough to have built up trusting relationships with industry
- Lack of natural talent to be a good communicator
- Lack of self-confidence
- Not knowing who to speak with in the industry
- Not knowing what the industry audience's level of existing knowledge on the topic is

- Uncertainty of what industry wants
- Perceiving industry to be conservative
- Perceiving industry to lack interest in research
- Perceiving industry to prefer speaking only to specific researchers
- Lack of desire to do KT

The first constraint of not being a researcher long enough to have formed trusting relationships relates to a researcher's age and experience. The influence of demographics such as age, gender, academic standing, etc., was not explored in this study due to its small sample size. Nonetheless, a young researcher participant mentioned it as a constraint to his KT activities. The impact of biological and academic age on knowledge transfer and engagement has been investigated in various studies and surveys (Levin & Stephan, 1991; D'Este & Patel, 2007; Bercovitz & Feldman, 2008; Boardman & Ponomariov, 2009; Giuliani et al., 2010; Tartari & Breschi, 2012; Abreu & Grinevich, 2013; Aschhoff & Grimpe, 2014; Huyghe & Knockaert, 2015; Hughes et al., 2016; Iorio, Labory & Rentocchini, 2017; Kongsted et al., 2017; Lawson et al., 2019). Some studies and surveys found a positive correlation with increasing age, whether it's biological or academic age. Others saw a curvilinear effect, and some found no effect. The participant in this study, who felt his young age was a constraint, attributed "longer years as lecturers" to why some of his colleagues have better ties with industry than him. They tend to engage with former students.

One participant mentioned the lack of talent to be a good communicator. This comment can, in one way, be linked to the personality types of researchers. Many researchers are introverted by nature. According to Joubert (2018), these researchers' ability to isolate themselves and focus on their research can be key facilitators of academic success. Researchers are, however, aware that this presents a challenge in presenting their work to external audiences. Empirical studies investigating researchers' propensity to engage with industry based on their personalities are very scarce due to the difficulties in determining and measuring personality traits (Joubert, 2017). Generally, researchers with more outgoing personalities would be more likely to engage with external audiences.

Another way to interpret the participant's comment is her perception that researchers need the talent to communicate. That is not necessarily true. While it will undoubtedly help, knowledge transfer skills can be taught, and researchers can improve with practice. Researchers can also focus on KT channels they are the most comfortable with (Joubert, 2017). One must also accept that some researchers are simply not suited to communicate with industry. It is suggested that research institutes identify scientists who can communicate and are motivated and interested and support them.

Lack of confidence was mentioned as a constraint by one participant. The participant acknowledged that this was because she was uncertain of her communication skills. Researchers can, however, through training, increase their communication competencies (Joubert, 2017). Researchers can also be assisted by intermediaries (individuals or organisations), providing guidance and facilitation for KT activities.

The following three constraints mentioned by participants can be grouped since they can all be viewed as issues related to tie strength between university and industry. Tie strength is the frequency of communication and interaction between entities sharing knowledge (De Wit-de Vries et al., 2018). These constraints are "not knowing who to speak with in industry", "not knowing what the industry audience's level of existing knowledge on the topic is", and "uncertainty of what industry wants." Researchers need to sustain a pattern of interaction over time to better understand their audiences' needs and expectations. Frequent interactions lead to a shared knowledge base and trust, and according to various authors, trust facilitates knowledge sharing (Battistella, de Toni & Pillon, 2016; Rutten, Blaas - Franken & Martin, 2016; De Wit-de Vries et al., 2018). Researchers must engage in dialogue with industry and listen to industry's questions, concerns and expectations to form a common understanding and develop shared values. It is a process that takes time. Intermediaries can help facilitate the process by suggesting "who to speak with" and sharing their experiences on challenges experienced by the industry.

The last four constraints were mentioned by participants who prefer doing basic research and are generally less interactive with industry than their colleagues. The mentioned constraints are perceiving the industry as conservative, lacking interest in research and preferring speaking to specific researchers only. One participant also indicated a lack of desire to interact with industry if not needed. Hughes et al. (2016) reported similar findings in their study of UK scientists with academics involved in more basic research more likely to report difficulty in finding people to engage with, as well as external audiences lacking research interest. They also found that non-interacting researchers are likelier to say they lack communication skills with external audiences.

In conclusion, the most cited constraints by respondents from the Danish survey by Kongsted et al. (2017) were "conflicting goals in industry and academia" and "conflicting time frames in industry and academia," which supports the "two communities" theory. Researchers in the current study confirmed these findings in their mentions of perceived institutional, organisational and individual barriers to engagement and KT. When goals and time frames are believed to be conflicted, the potential exists for industry funding and industry engagement to affect research quality and direction negatively. This is discussed in the next section.

7.2.6 BENEFITS AND DRAWBACKS OF INDUSTRY ENGAGEMENT

7.2.6.1 Research productivity

The oenology researchers reported that industry engagement had an overall positive influence on their academic careers. The benefits mentioned by the participants satisfy their intrinsic and extrinsic motivations for engaging with the industry. Participants reported that engagement leads to funding, which allows them to do publishable research. The concern that researchers with industrial support will publish less (Perkmann et al., 2013) was not experienced by these participants. This is in line with earlier findings discussed in Chapter 2 of this dissertation. (Blumenthal et al., 1996; Landry, Traore & Godin, 1996; Breschi, Lissoni & Montobbio, 2007; Hottenrott & Lawson, 2017). A study by Callaert et al. (2015) reported that when researchers initiate projects themselves, their collaborations with industry resulted in higher scientific outputs than when reacting to requests. This finding was also confirmed by three participants in the current study who found that sometimes the research requested by the industry is not publishable. One participant referred to it as more like testing than actual research.

7.2.6.2 Research quality

Participants reported both positive and negative consequences for publication quality in terms of the journals in which they publish. Some participants reported being able to publish industry-funded research in journals of their choice, with good reputations and high impact factors for their subject fields, such as *Journal of Agricultural and Food Chemistry* (IF 5.279, 2020), *Nature Scientific Reports* (IF 4.379, 2020), *Food Chemistry* (IF 7.514, 2020), *Frontiers* (5.640 *F. Microbiology*, 2020) and *Molecules* (IF 4.411, 2020). These are not viticulture and oenology-specific journals but cover broad aspects of natural and agricultural sciences. Other participants reported occasionally having trouble publishing in journals with high impact factors. It is believed by these participants that applied research does not always present with high enough novelty and scientific rigour to be published in high-impact journals. This supports the findings of other authors who reported that although publication output can be higher for collaborative (with industry) researchers, the average impact factor of the journals they publish in was lower (Abramo et al., 2009; Hottenrott & Lawson, 2017).

Publication quantity (number) and quality (journal reputation and impact factors) play crucial roles in individual researchers' and universities' scientific reputations, and the participants of this study and Stellenbosch University are no exceptions. Because of its relevance to this study, scientific publication, including the peer review process and journal impact factor, was discussed in detail in Chapter 2.

Participants in the current study are fully aware of and agree with the shortcomings of the impact factor (IF). They believe the quality of the individual article is more important than the IF of the journal. To them, the number of citations they receive is more important than the IF of the journal they publish in. Unfortunately, viticulture and oenology are very specialised subject fields and publishing in subject-specific journals can potentially limit their exposure and subsequent citations. Publishing in broader natural and agricultural science journals is better suited to their academic standings and career possibilities. Therefore, it is vital for this study's participants to find the perfect balance between excellence and relevance so that they can publish in journals with good reputations and high impact factors and meet the expectations of their industry funders. However, the onus cannot just rest upon the shoulders of researchers to try and be as relevant as possible to satisfy the industry. The industry needs to be fully aware of how academia operates, whether they agree with it or not, seeing that it is a global enterprise compared to local industry. The industry, therefore, needs to find a compromise that can accommodate academic rigour.

7.2.6.3 Research direction

Most of the participants in the study indicated their research to be more applied in nature because they receive industry funding because it is their choice to be pragmatic because of their backgrounds or any combination of these three factors. Even though they classify their research as applied, they indicated that they design the projects in such a way that it contains enough academic rigour to satisfy the university’s expectations. Three participants (27%) indicated that they prefer doing basic research. They emphasised the importance of basic research as the foundation upon which applied research and eventually experimental development and innovation can be built. One of these participants expressed concern about the lack of basic research in South Africa due to the lack of public funding. Hughes et al. (2016) reported that 26% of their survey participants viewed their research as primarily basic, 26% considered their research primarily use-inspired, and 43% pure applied.

Various studies have investigated the concern that private funding skews the research agenda towards applied research at the expense of basic research (Hicks & Hamilton, 1999; Thursby & Thursby, 2002; Van Looy et al., 2004; Van Looy, Callaert & Debackere, 2006; Bozeman & Gaughan, 2007; Ylijoki, Lyytinen & Marttila, 2011; Bentley, Gulbrandsen & Kyvik, 2015; Quaglione, Muscio & Vallanti, 2015). In general, the studies did not find this to be the case. Even though there has been a tremendous increase in applied research, it was not due to replacing basic research, especially in the traditional basic research disciplines such as physics, chemistry and mathematics.

Participants did indicate that the overall research agenda of the Department of Viticulture and Oenology will most likely shift to being more basic research if they were no longer dependent on industry funding. It is easier and better suited to their academic careers to have academic freedom to choose what to research, how to research it, and if and when they engage with industry in knowledge-related activities. It is worth noting that in South Africa, academic freedom is a constitutional right:

> The principle of academic freedom implies the absence of outside interference, censure or obstacles in the pursuit and practice of academic work. It is a precondition for critical, experimental and creative thought and therefore for the advancement of intellectual inquiry and knowledge, academic freedom and scientific inquiry are fundamental rights protected by the Constitution. ("White paper on Higher Education Transformation," 1997)

Interestingly, 23% of participants in the Danish survey indicated that engagement with external stakeholders limits academic freedom (Kongsted et al., 2017).

In conclusion, research direction can be influenced by private funders' needs. This is not necessarily a negative situation for science. If a trusting relationship exists between academia and industry, both communities can achieve their desired outcomes, i.e., excellence and relevance, without putting academic freedom in danger. Van de Ven and Johnson (2006) call such a relationship between academia and industry engaged scholarship, based on the concept of arbitrage, a dialectal process between researchers and industry stakeholders in the design of projects and their outcomes.

7.2.7 CONCLUSIONS: RESEARCHERS

The purpose of the researcher interviews was to explore the knowledge-related, boundary-spanning engagements between the community of academic researchers and the community of practitioners from the researchers' perspectives. A specific agricultural research domain was chosen as the focus of the study, i.e., oenology – the study of winemaking. A qualitative approach was followed, and 11 researchers were interviewed. These 11 participants represent the full complement of academic oenology researchers at the Department of Viticulture and Oenology, Stellenbosch University, at the time of the interviews.

The academic community is generally dominated by the pressures to publish or perish (Rajaeian, Cater-Steel & Lane, 2018). Researchers' careers are determined by how many publications they have in top-ranked journals. These top-ranked journals seldom evaluate the practical relevance of the papers they publish. In such an environment that favours traditional academic outputs, researchers will only interact with industry practitioners if there is a benefit for them. Researchers can be intrinsically and extrinsically motivated to transfer knowledge to the industry.

This study found that all the participants have, or have had, engagements with industry funders and winemakers. The results indicate that participants primarily interact with industry because it is a prerequisite to industry funding. A smaller percentage engage because they are purely intrinsically motivated. What was very evident from the study is that the most significant determinant of frequent industry engagement was the individual researcher's personality and intrinsic motivations. These results support the findings by Rajaeian et al. (2018) and the suggestion by Perkmann et al. (2013).

The study also found that the organisational environment did not support knowledge transfer activities. This finding supports the results obtained by various earlier studies that listed lack of organisation support as a barrier to knowledge transfer activities (Jacobson, Butterill & Goering, 2004a; Hughes et al., 2016; Joubert, 2017; Kongsted et al., 2017; Kruss & Visser, 2017).

In terms of institutional factors, the discipline of oenology being an applied science is conducive to knowledge transfer whilst national factors within the South African setting promote traditional academic outputs, feeding the publish or perish culture.

7.3 THE INFORMATION-SEEKING BEHAVIOURS OF SOUTH AFRICAN WINEMAKERS AND INTERMEDIARIES

7.3.1 FACTORS INFLUENCING PRACTITIONERS' KNOWLEDGE TRANSFER, UPTAKE AND UTILISATION

Knowledge is a powerful tool that can assist practitioners in making informed decisions. Knowledge can lead to innovation, giving individuals and companies a competitive advantage. The findings of the empirical study involving South African (SA) winemakers and intermediaries are discussed in this section. They are divided according to the factors influencing practitioners' knowledge transfer, uptake and utilisation. These factors include the individual characteristics of practitioners, the characteristics of the knowledge source, the nature of the knowledge transferred, the knowledge transfer channels used and the role of intermediaries (Rogers, 2003; Al-Salti, 2011; Hill et al., 2015; Hoffman, Lubell & Hillis, 2015; Battistella, de Toni & Pillon, 2016; De Wit-de Vries et al., 2018).

The knowledge transfer channels and the role of intermediaries were also identified as boundary-spanning activities that facilitate the knowledge flow from academic research to practitioners and vice versa. Their value as boundary spanners between the oenology researchers of the DVO and winemakers is also discussed.

7.3.2 PRACTITIONERS' INDIVIDUAL CHARACTERISTICS

Individual characteristics of practitioners that can influence their knowledge uptake include their learning intent, adsorptive capacity, motivation and rewards, values and beliefs, innovativeness and their centrality in the knowledge network (reviewed in Chapter 3).

7.3.2.1 Learning intent

Benchmarking the learning intent of SA winemakers can be approached from various angles. One could look at the frequency of knowledge sources used as indicated in the web survey. However, these knowledge sources can be used for the intrinsic desire to learn something new (learning intent) and problem-solving, and the web survey results do not distinguish between the two types of use. Some of the intermediaries interviewed in the study confirmed that most of the conversations they have with winemakers, which winemakers have initiated, were to solve problems.

Another way would be to look at winemakers' level of agreement with statements in the web survey. Regarding the statement "I make the time to gather as much information on winemaking as possible from various resources", 8% of participants strongly agreed, and 46% agreed. This can be interpreted as 55% of winemakers realising the importance of continuous learning, i.e., and can be viewed as having a strong learning intent.

If one looks at the five winemaker types identified for the interviews, the group that stood out is the 'geeks' due to their significantly higher incidence of factual learning. However, just because some winemakers prefer social learning by attending tastings, study groups and seminars do not make their learning intent any less. From the data obtained in this study, the best way probably to determine the learning intent of SA winemakers is to look at the winemaker groupings made by the interviewed intermediaries. Based on the comments from the intermediaries and the frequency of resource use indicated by participants, most SA winemakers fall within the first three groups. Table 7.2 demonstrates the grouping of SA winemakers based on their learning intent as described by the intermediaries.

Two other wine industry-related studies divided grape growers and winemakers into groups. A study by Dippenaar (2017) divided SA grape growers according to their resource use, and Szymanski and

Davis (2015) segmented Washington grape growers and winemakers based on their attitudes towards winemaking. The winemaker 'learning intent' groups from the current study can only loosely be compared with the Washington groups of science-driven, vision-driven, utility-driven and pensive grape growers and winemakers. Whereas some of the individual characteristics of the SA winemakers and Washington grape growers and winemakers overlap, the SA winemakers could not exclusively fit into any of the Washington winemakers' groups.

Table 7.2: Winemaker groups based on their learning intent

Innovative (53% of winemakers surveyed) (strong learning intent)	Facts-driven	This winemaker group is very interested in new winemaking information (including research) and new products and processes. They need more than just the practical application guidelines. They want the underlying scientific facts. They probably regularly "scan" written resources for something "relevant" to their winemaking and utilise interactive knowledge transfer channels. They have preferred suppliers they trust for scientific accuracy and sound practical advice. They most likely immediately try out an innovation.
	Practice-driven	This group is very similar to the facts-driven group, except that they are less interested in all the underlying scientific facts of an innovation. They also have preferred suppliers that they trust for sound practical advice. They are less likely to consult facts-based written materials and prefer interactive knowledge transfer channels such as study groups and seminars. They obtain a lot of information and ideas for experimentation from other winemakers.
Set-in-their-ways	Informed (Medium leaning intent)	This group of winemakers entertain new information and enjoy interactive knowledge transfer events. They are not necessarily open to putting the new information they received into practice due to their firm belief that what they are doing works best in their "set-ups."
	Uninformed (Low learning intent)	This group is not interested in learning about or trying something new. They tend to follow the same 'recipe' they have followed for years. They use interactive knowledge transfer channels, usually for the social aspect of it or to solve a problem they most likely caused themselves.
Production-driven	Uninformed	This group of winemakers is less focused on final wine quality. They are probably the ones who cut corners and have "no idea" what caused their problems. Their preferred suppliers are the ones with the lowest prices for their products. They will try new products and processes simply because it is cheaper.

7.3.2.2 Absorptive capacity

The absorptive capacity of individuals is linked to their prior knowledge and experience. It predetermines the levels of familiarity and comfort with new information and facilitates uptake (Lee, 2001; Srivardhana & Pawlowski, 2007). Compared with other professions in the wine industry and outside the industry, winemakers have a greater absorptive capacity for new winemaking information due to their formal training and years of experience as a winemaker. Only 9% (Table 6.3) of study participants indicated that they don't have any formal oenology-related qualifications. They obtained their winemaking knowledge through experience (experiential learning) and self-directed factual and social learning. This figure is slightly less than the earlier study among SA winemakers, where 11% indicated they have no formal oenology-related qualification (Boshoff, 2012). As a result of their formal training and experience (only 17% of the participants were younger than 30), most winemakers in this study should be able to understand new practical winemaking information quite easily. Their understanding of new factual information will be determined by their previous experience with factual information and their learning intent.

7.3.2.3 Motivations and rewards

Practitioners can be intrinsically and extrinsically motivated to learn something new (Al-Salti, 2011). Winemakers in the current study were not explicitly asked what encourages them to engage with knowledge sources. One can, however, assume that when winemakers consult resources, it is because they hope to learn something new. It is difficult to tell whether learning new things is to keep their jobs and earn a salary or because they find the information interesting. However, the geeks, other facts-driven winemakers and some of the intermediaries engage with factual winemaking information continuously rather than just ad hoc, which is the case for most winemakers. They can be intrinsically motivated to obtain new knowledge because they find the information interesting and personally satisfying.

7.3.2.4 Values and beliefs

According to Rogers (2003), practitioners will not expose themselves to new knowledge and innovations if it is not in line with their values and beliefs. Practitioners will also not assimilate new knowledge if they believe it is irrelevant to their context. Winemakers can have different types of beliefs. The first one is the belief in information's relevance. Most interview participants mentioned that they only "scan" the traditional sources of scientific information (such as *Winetech Technical* in

WineLand magazine and the *Winetech Scan*) to “see” if there is something relevant for them. Only when they believe the information is relevant will they read further.

Winemakers can also hold beliefs that are not entirely true, based on past experiences. Two interviewees mentioned not having read the technical articles in *WineLand* for a while because they perceived them to be “always about the same two topics” and because they are “not relevant” to what he does on “his level.”

The third type of belief winemakers can have, is that their winemaking knowledge is enough, with 30% of participants believing this according to the web survey. Such an individual will not be very motivated to take up new winemaking knowledge.

The fourth type of belief is that the status quo is good. These winemakers are the ones described as being set in their ways. Intermediaries report that convincing such individuals to try something new is incredibly difficult. Usually, ‘older’ winemakers believe they have figured it all out based on their experiences. The Boshoff study also reported this finding (Boshoff, 2012).

The fifth type of belief some winemakers in the SA wine industry have, as mentioned by one of the intermediaries, is that winemaking should be as non-interventionist as possible. As a result, they will develop problems but refuse to take the advice to solve them because they refuse to intervene further in the winemaking process. They will instead bottle the problem and call it a vintage effect. This is different from the ‘minimalistic’ approach of winemakers in the Boshoff study (2012), where winemakers try to intervene as little as possible but will intervene if necessary to preserve wine quality.

Finally, winemakers can think that what they do is the best cause of action to create a specific wine style or prevent problems and maximise wine quality. This opinion and belief can be entirely accurate and have a scientific explanation that the winemakers are unaware of. Or the belief can have a potential scientific base, but the research to explore the belief’s ‘factuality’ has not been conducted yet (Boshoff, 2012).

7.3.2.5 Innovativeness and centrality

According to results from the web survey, 53% of SA winemakers are ‘innovators’ based on the classification by Rogers (2003). At face value, one can argue it is a rather good result because many actors in the knowledge network can corroborate innovations' advantages, thereby speeding up the diffusion of innovations.

Boshoff (2012) identified opinion leaders amongst SA winemakers by asking participants of a web survey how often other winemakers asked them for advice. Participants who indicated they were approached by peers at least once a month were regarded as opinion leaders. He identified 33% of his study participants as opinion leaders. Opinion leaders, like innovators, are essential in disseminating knowledge. The current study asked the same question and identified 46% of participants as opinion leaders.

Two criteria for selecting the 'geeks' typology were that they must be innovators and opinion leaders. Asking a similar question as Boshoff (2012) of what underlies the knowledge of opinion leaders (and innovators) revealed that factual knowledge and the use of written resources stood out for the four selected interviewees (Table 6.18).

7.3.3 CHARACTERISTICS OF THE KNOWLEDGE SOURCE

The distance between the practitioner and the knowledge source and the credibility of the knowledge source can influence the efficacy of knowledge transfer. The distance can refer to geographical distance, cultural distance and knowledge base distance (Caplan, 1979; Cummings & Teng, 2003; De Wit-de Vries et al., 2018).

The four primary sources of knowledge related to winemaking in the current study are the DVO, Stellenbosch University and its oenology researchers, Winetech, the industry research and knowledge transfer funding body, and suppliers of oenological products and services and winemakers. Independent consultants are used to a lesser degree.

Geographical distance is not a significant factor in the SA wine industry since the biggest part of the wine industry is situated in the Western Cape (not more than a four-hour drive by car from Cape Town). A cultural difference only exists between the researcher community and the winemaking community, one of the focus points of this study. Distance from the knowledge base is also a factor for oenology researchers and winemakers.

Credibility is the extent to which people believe a knowledge source is trustworthy and reputable (Ko, Kirsch & King, 2005). Credibility plays a considerable role in the SA wine industry. Winemakers have high regard, as indicated by their level of trust, for the DVO researchers, Winetech and other winemakers. They also highly regard certain supplier companies, their resources, and those who work for them. This does not translate to all suppliers.

7.3.3.1 The DVO as the knowledge source

More than half of the winemakers in the study have degrees in oenology and viticulture from the DVO. Some have post-graduate degrees in oenology from the DVO. The winemakers who studied at the DVO were familiar with some of the oenology researchers since they were their lecturers. Various winemakers who did not study at the DVO were also familiar with some researchers. Notably, almost all the winemakers interviewed knew the same two researchers and their specialities. Even when prompted, they rarely knew the other nine oenology researchers in the DVO at the time of the interviews. More than 30% of the participants indicated that they are unfamiliar with any DVO researchers. Despite a lack of familiarity, the DVO researchers scored the highest on the "trustworthiness of scientific accuracy" scale. Stellenbosch University's short courses and workshops also scored the highest for trust in their scientific accuracy compared to the other industry events. Frequency of use, however, told a different story, with researchers rarely consulted for winemaking information.

Various conclusions can be drawn from the web survey and winemaker interviews regarding the characteristics of the DVO as a knowledge source.

- The DVO is a trusted source of accurate scientific winemaking information.
- The DVO is mainly a source of factual knowledge.
- Except for two researchers, most DVO oenology researchers lack 'social capital' amongst winemakers due to weak tie strength. They are better known amongst intermediaries.
- Oenology researchers are rarely consulted for information by winemakers.
- There is a cultural difference between oenology researchers and winemakers, which is a barrier to knowledge transfer.

7.3.3.2 Winetech as the knowledge source

Winetech is responsible for publishing plain language technical articles in *WineLand* magazine. Winetech also publishes the *Winetech Scan* monthly and the final reports of industry-funded research on the Winetech website once a year. These sources mostly contain factual information about the latest oenology research. All the Winetech written resources scored highly in terms of the level of trustworthiness in the accuracy of wine science. *Winetech Technical* in *WineLand* magazine was consulted the most of the three written resources. Based on the results from the study, Winetech has the following characteristics:

- Winetech is a trusted source of accurate scientific information.
- Winetech is mainly a source of factual knowledge.
- *Winetech Technical (WineLand)* and the *Winetech Scan,* to a lesser degree, are well-known amongst winemakers and intermediaries.
- *Winetech Technical* and the *Winetech Scan* are well-utilised by most of the interviewed intermediaries.

7.3.3.3 Suppliers of oenological products and services as knowledge sources

Suppliers of oenological products and services are second to peers, winemakers' most prominent source of information. According to the web survey, winemakers frequently interact with individuals working for the suppliers, as well as their resources such as websites and email newsletters. Despite their frequent usage, suppliers also scored the lowest in terms of the accuracy of wine science. Suppliers have the following characteristics:

- Only some suppliers are viewed as trusted sources of scientific information.
- Suppliers and their resources are frequently consulted as sources of practical information.
- Suppliers have a vast amount of social capital (tie strength + trust) in the industry.
- Suppliers generally have closer relationships with some DVO researchers than winemakers.
- Suppliers have access to the information generated and supplied by their parent companies' extensive R&D departments.

7.3.3.4 Peers as knowledge sources

Winemakers place a very high level of trust in the accuracy of the information they receive from other winemakers. Winemakers regularly consult with each other and regularly meet in small groups such as tasting and study groups. They find their colleagues very helpful and very open to sharing information. Data from the current study indicate that:

- Winemakers are well trained at reputable institutes.
- Winemakers regularly consult with sources of winemaking information, especially other winemakers, the internet and suppliers of oenological products and services.
- Most winemakers are innovative and willing to help other winemakers.

- Winemakers supply other winemakers mostly with practical information. Colleagues can also be a source of tacit knowledge.
- Winemakers can have strong opinions and beliefs (with and without scientific bases) that inform their winemaking.
- Most winemakers are interested in the latest oenology research at the DVO.

7.3.4 THE CHARACTERISTICS OF THE KNOWLEDGE

Knowledge characteristics include the nature of the knowledge, its perceived usefulness, ease of use, observability and timing (Polanyi, 1966; Rogers, 2003; Hill & Hathaway, 2015).

7.3.4.1 The nature of the knowledge

Chapter 1 provided an overview of factual, practical, explicit and tacit knowledge. It is clear from the web survey results and the interviews that most winemakers prefer practical knowledge to factual knowledge. This finding is supported by an earlier study that found that SA winemakers consider practical knowledge their most important knowledge source (Boshoff, 2012). This does not mean winemakers are not interested in factual knowledge. Most winemakers also consult factual knowledge, as the results for the frequency of use of written resources in the web survey indicate. For instance, only 2% said they never use the internet, and 10% said they never read *Winetech Technical* in *WineLand* magazine.

Regarding face-to-face communication of factual knowledge, one of the intermediaries explained that there are different layers of communication with winemakers and used the metaphor of an onion. The first layer of the onion winemakers requires only the usage protocol of new technologies. The innermost layer of the onion winemakers needs the scientific basis upon which the technology is based. Most SA winemakers lie somewhere in between, dispersed over the layers.

One can also view sources of factual knowledge in terms of a spectrum, starting with scientific articles, followed by the SA wine industry conference where researchers present their latest research results, plain language *Winetech Technical* articles, the *Winetech Scan*, technical blogs and supplier emails containing small amounts of facts supporting their products’ usage. South African winemakers, in general, are more likely to read simplified, small pieces of technical information than attend the SASEV conference (71% never attend).

7.3.4.2 Perceived usefulness

It can be argued that winemakers regularly consult with supplier knowledge because it concerns the use of products they already use or plan to use. Reading about or listening to the latest research results may or may not be immediately useful, as some winemaker interviewees (eschewers and marketers) alluded to. They indicated that they are only interested in research results when it has already become a product or if it is information that is immediately useful in their environment.

7.4.4.3 Ease of use

Ease of use was not investigated as a factor influencing knowledge uptake in the current study. However, some intermediaries commented that winemakers occasionally 'cut corners' or don't follow communicated protocols. They gave various reasons (don't have the time, don't have the financial resources, deliberately taking chances), but another could be that winemakers perceived it challenging to implement a protocol in their specific environment.

7.4.4.4 Observability

The observability of innovations is very important for the interviewed winemakers. That is one of the main reasons they prefer tasting and study group meetings and cultivar group seminars where wine is presented as part of a knowledge exchange exercise. One winemaker described the shortcoming of written material as you cannot smell and taste the results from the research or a trial. Suppliers also play a vital role in the observability of innovations through their seminars, where they usually have wine tastings to demonstrate their products' effects on wine aroma or stability. Suppliers also do trials with their products at the winery to provide tailored solutions for winemakers in their specific conditions. Hill et al. (2015) found that when the 'usefulness' of technology is demonstrated and evaluated by grape growers and winemakers, it increases the likelihood of adoption.

7.4.4.5 Timing

Winemaking is a process. You harvest, you ferment, you stabilise, you bottle. It comprises many steps requiring informed decisions, deeply rooted in science, by winemakers before the final product is ready to be sold. Winemakers are open to information relevant to the part of the process they find themselves in. For example, winemakers are not necessarily open to new information about wine yeasts when they have just finished a three-month harvest season. Suppliers are very good at tailoring their communication according to the predominant processing steps because of their commercial interests. This makes them a popular knowledge source for the different processing steps.

It is not always possible for *WineLand* and Winetech to wait for the correct time to publish new information since they publish as the information becomes available. One person's correct time could also be another person's wrong time. With written resources, information could go unnoticed until someone searches the internet and finds it.

The *WineLand* and Winetech websites in South Africa, and the AWRI[34] website in Australia, for instance, serve as knowledge reservoirs that winemakers can delve into when the need or interest arises. When winemakers Google something winemaking-related, chances are their countries' resources, which contain the most winemaking information, will appear on the first page of a Google search result due to the search engine optimisation of these websites. Chances are that other countries' technical winemaking sites will also appear if they have published something on the same topic. Relating this to timing, one can thus argue that these resources are available at the exact time that winemakers need them, in a 'demand-pull' way.

Google, therefore, contributes to the concept of knowledge creep, as described by Weiss (1979) and found by Boshoff (2014a) to play a significant role in SA winemakers' knowledge. Boshoff referred to peers and the internet contributing to SA winemakers' knowledge creep. Search engine optimisation and Google indexing have advanced significantly since the Boshoff study. Chances are even bigger now that SA winemakers regularly find the information they are looking for on the *WineLand* website through a generic Google search but cannot recall where they found it later. Interestingly nearly half of Washington grape growers and winemakers indicated that they rarely or never use the internet for information (Szymanski & Davis, 2015). As it goes with evaluation studies, it is something that could have evolved since the time of the survey.

7.4.5 KNOWLEDGE TRANSFER CHANNELS

This study explored the usage of 36 knowledge transfer channels available to winemakers in the SA wine industry. These knowledge transfer channels included unidirectional and interactive channels or learning pathways, as referred to by Lubbell et al. (2014). This study builds on three previous academic studies that investigated the resource use of SA winemakers (Boshoff, 2012), SA grape grower opinion

[34] Australian Wine Research Institute

leaders (Dippenaar, 2017), Washington (USA) grape growers and winemakers (Szymanski, 2016) and one Australian non-academic survey of grape growers and winemakers (Hill et al., 2015). These studies found that grape growers and winemakers use a combination of knowledge transfer channels based on their individual information-seeking behaviours.

Boshoff (2012) found that the most frequently used sources of information for SA winemakers were peers (other winemakers), the internet, the *Wynboer* (nowadays *Winetech Technical*) and consumer opinions. Consumers as a source of information were not explored in the current study since even though they can significantly influence the style of wines produced, they are not a source of factual and practical winemaking information, which was the focus of the current study.

Dippenaar interviewed 15 grape-growing 'opinion leaders' (producers) in the SA wine industry. Participants were asked what their preferred primary and secondary knowledge transfer channels were, and according to their answers, these channels were ranked in importance. The preferred sources of knowledge for the 15 opinion leaders were consultation and extension services (like those offered by Vinpro), peers (other producers), popular media publications (such as *Winetech Technical* and *WineLand*) and the internet.

Szymanski surveyed Washington grape growers and winemakers regarding their frequency of knowledge sources used to obtain new grape growing and winemaking information. Their most used knowledge sources were trade magazines (80% access it as print copies), peers, face-to-face seminars and workshops (which can include supplier seminars) and extension newsletters/other publications.

Hill et al. (2015) investigated who in the Australian wine industry was adopting innovations, what they were adopting and why and where grape growers and winemakers were getting information when making adoption decisions. The two most frequently used information sources consulted when considering adopting an innovation were the internet and peers, with 95% of winemakers utilising the internet first when seeking information.

The current study found that the most frequently used sources of information for SA winemakers, according to the percentage of participants indicating they use them once a week, are winemaking colleagues at the same cellar (58%), the internet (42%), supplier websites (17%) and supplier and service provider emails (14%). Interestingly three of them are written resources. The frequency of use is not necessarily an indication of preferred use, and it should be noted that these frequently used resources are readily available. In contrast, others, such as printed trade magazines, are only published monthly. Events also happen anywhere from once a month to once a year.

Approaching resource use from a different angle, interview participants were asked who and what they would consult if they encountered a problem they didn't know how to solve. Most indicated they would contact a supplier, service provider, or consultant (interactive channels). Only two 'geeks' mentioned that they would consult their written resources first.

Regarding innovations, SA winemakers' most prominent sources of innovation information are peers and suppliers of oenological products and services. This information is shared in individual face-to-face meetings and at tastings, study group meetings and supplier/service provider seminars. According to the results, 68% of participants in the web survey indicated that they attend winemaker study and tasting group events more than four times a year, which makes it the most popular event for winemakers to obtain new knowledge. Only 2% of participants indicated that they had never attended such events. This is supported by the finding from Hoffman et al. (2015) that informal, social learning channels are used far more than formal resources to learn about vineyard management practices in four grape-growing regions of California.

In addition to the internet and supplier written resources, 42% of participants indicated they consult *Winetech Technical* articles in *WineLand* once a month when published. Like the Washington winemakers, they prefer the printed magazine to the website. Oenology textbooks were also popular, with only 13% of participants indicating that they never use them. According to Szymanski (2016), written science communication makes the science relevant to an audience in general and does not create a relevant relationship with individuals in the audience. Most SA winemakers prefer context-specific knowledge transfer channels, especially interactive ones, which will explain their lower frequency of use of *Winetech Technical* articles compared to peers and suppliers as knowledge sources. Hill et al. (2015) found that grape growers and winemakers in the Australian wine industry seek and value the opinions of other winemakers and classified it as a significant driver of adoption in the industry. According to the authors, the information shared between winemakers is usually practical, experience-based, independent and trusted, which makes it very influential.

South African winemakers rarely consult with academic researchers, attend the SA industry conference or read scientific articles. In contrast, a quarter of the Washington grape growers and winemakers often contacted university extension faculty as their primary resource (Szymanski & Davis, 2015).

Social media is rarely used as a source of winemaking information by SA winemakers. This finding is supported by the results from the Washington study, where 64% of survey respondents indicated they never use Facebook, and 88% never use Twitter as sources of winemaking information (Szymanski, 2016).

7.4.6 THE ROLE OF INTERMEDIARIES

Intermediaries play a crucial role in the technical knowledge network of the South African wine industry. The most important intermediaries are Winetech, Vinpro, independent consultants and suppliers of products and services related to viticulture and oenology. The landscape looks slightly different for winemakers, and producers and viticulturists. In the case of primary production (producers and viticulturists), Vinpro plays a prominent role with its regional consultancy services, information days, study group meetings and the Gen Z vineyard project. All three of these knowledge transfer activities are co-funded by Winetech, which does not have the infrastructure and personnel to host interactive knowledge transfer activities. Vinpro does not supply the same level of service to secondary production, i.e., winemaking. Winemakers have come to rely on their peers and suppliers and, to a lesser degree, their independent consultants for most of their practical information.

Of all the intermediaries, Winetech is the closest to academic research and the oenology researchers of the DVO. Winetech's two communication channels, both unidirectional and factual, *Winetech Technical* in *WineLand* magazine and the *Winetech Scan,* are widely used and trusted by the industry. These resources play an essential role in creating awareness of new research and serve as knowledge reservoirs for winemakers who often seek information on the internet. The printed magazine, distributed to most industry practitioners monthly, also leads to accidental learning since winemakers page through the magazine to see if there is anything relevant and useful to them, which they then read. The value of print in the digital age should therefore not be underestimated.

Winetech's primary role in terms of knowledge transfer in the industry is the dissemination of knowledge. Other intermediaries such as suppliers of oenological products and services promote the dissemination of information and practical uptake. They are more successful in promoting knowledge utilisation than Winetech because they can provide context-specific knowledge based on the practical experiences of all their clients who have already trialled the innovations, including winemakers from other countries. Due to suppliers' frequency of communication with winemakers (due to their commercial interest), they are also much more in tune with how winery operations work, which includes the economics of winemaking.

Suppliers also bring the knowledge created by the Research and Development (R&D) departments of the companies they represent. These R&D departments spend huge budgets on research at international research institutes. Most of their research will be in the application context since they expect a return on investment. Some of their commissioned research also happens at the DVO. Especially research related to wine yeasts and lactic acid bacteria. Some of the commercial products available in the SA wine industry have been developed or researched by DVO researchers. In many cases, Winetech-funded research laid the foundations for the applied research that led to the commercial recommendations for using specific products.

Intermediaries that work for suppliers provide valuable input on Winetech committees into which projects should be funded and the expected outcome based on their insights into winemaking and winemakers' needs and knowledge uptake behaviours.

Finally, the ten intermediaries interviewed as part of this study make a vital contribution to the winemaker knowledge network because of their intrinsic motivation to learn and to provide learning to winemakers, despite their commercial interests.

7.4.7 CONCLUSIONS: WINEMAKERS AND INTERMEDIARIES

This concludes the section on the information-seeking behaviours of winemakers and intermediaries in the SA wine industry. This section aimed to sketch a picture of the community of winemakers and the ways they obtain new information related to their trade, winemaking. The results showed that scientific facts play an essential role in their winemaking decisions but that it often reaches them indirectly through experiential and social learning rather than factual learning. Factual learning happens more ad hoc, whereas experiential and social learning is more continuous and preferred. Suppliers tie in with experiential and social learning through their trial offerings and interactive face-to-face meetings with winemakers. They can also provide context-specific information at the right time, whereas factual resources are more generic and aimed at a wider audience.

The sources of factual knowledge are the foundations on which winemakers and intermediaries' experiential and social learnings are built. The most important sources of factual knowledge are the DVO, Stellenbosch University and the Elsenburg Agricultural Training Institute, which provide winemakers with the absorptive capacity for new winemaking knowledge.

Compared to other studies involving winemakers, a significant result is the crucial role suppliers of oenological products and services play in the SA winemakers knowledge network. This was not so evident in the previous study involving SA winemakers (Boshoff, 2012) and is a phenomenon that has evolved since then. The reason could be that suppliers started to realise that knowledge is power, as the saying goes and have begun to employ highly qualified and experienced individuals that are not just good at sales but also very technical and thus very good boundary spanners between theory and practice. One could question why it is not the case where the other winemaker studies were conducted, i.e., in the USA and Australia. One possible explanation can be the existence of universities

(UC Davis, Washington State University, Oregon Wine Research Institute, Cornell University, Virginia Tech etc.) and research institute (AWRI) extension services, which are largely absent in SA. That has left a knowledge gap in the SA wine industry, which suppliers and Winetech largely fill.

Finally, winemakers and intermediaries agreed that SA has enough winemaking knowledge sources and knowledge transfer channels. Winemakers are diverse in their information-seeking behaviours. In some cases, their immediate environment will influence their knowledge uptake, i.e., their administrative or sales and marketing activities. However, in most cases, their personalities and interests determine their willingness to engage with knowledge sources and to take up new information.

7.5 BOUNDARY-SPANNING ACTIVITIES BETWEEN OENOLOGY RESEARCHERS AT STELLENBOSCH UNIVERSITY AND SOUTH AFRICAN WINEMAKERS

Contract research, written publications (open access publications and plain language articles in practitioner magazines), presenting at practitioner events and ad hoc interactions were explored as boundary-spanning activities between the oenology researchers and winemakers in the current study (Boshoff, 2012; Perkmann et al., 2013; Szymanski & Davis, 2015; Dippenaar, 2017; Basson, 2019). These are not the only boundary-spanning activities between academia and non-academic stakeholders. Examples of other boundary-spanning activities include co-supervision of students, staff exchanges, serving on technical or scientific advisory boards, public lectures at schools, museums and community organisations, media interaction (e.g., television and radio) and entrepreneurial activities (Perkmann et al., 2013, 2021; Iorio, Labory & Rentocchini, 2017; Kongsted et al., 2017). The role of intermediaries in facilitating these boundary-spanning activities was also explored.

7.5.1 COLLABORATIVE AND CONTRACT RESEARCH

In terms of collaborative and contract research, it was found that collaborative research, where academia and industry both conduct empirical research and co-publish, did not happen at the DVO at the time of the interviews. There is, and was in the past, a significant amount of contract research, especially with the intermediary, Winetech. Researchers also reported doing contract research for international suppliers of oenological products.

Most researchers found the contract research interactions with industry (national and international) beneficial. In addition to being a source of funding, it enables them to gain industry knowledge, benefits their research agendas, research outputs, and academic careers, and leads to enjoyment and personal growth. From their perspective, contract research is a valuable boundary-spanning activity.

The web survey and interviews with winemakers revealed that some had been involved in research projects with the DVO. Their involvement is limited to a conversation in the concept phase of the funding application, the donation of juice, must or wine, or sensory analysis of research results.

It does not bother winemakers that they are not more involved. Most winemakers are not interested in the research process. They are happy to wait until the end of the project to hear about it for the first time and only if they perceive the results to be beneficial to them. Some winemakers who were involved with sensory analysis felt that they would have liked to receive more feedback from the oenology researchers afterwards on the outcome of the sensory analysis.

Researchers interact mainly with their industry funders (intermediaries) of the contract research during the project cycle and not with winemakers. Despite the few winemakers who reported that they have interacted with industry, all the interviewed winemakers indicated their willingness to interact with researchers. They felt that it would benefit both parties to interact more. They want researchers to visit them and see and hear how they approach winemaking at their specific cellars and why.

7.5.2 OPEN ACCESS SCIENTIFIC PUBLICATION

Access to scientific publications was limited to the scientific community and a few technical-minded individuals outside academia who had access to scientific journals through their institutions. With the arrival of open access publications, increasing amounts of information became available to anyone with a computer and an internet connection. Participants in the current study were asked about their publication behaviours and the role of open access in their choices of journals for publication. From the researchers' side, open access publication is not a boundary-spanning activity between them and the industry for three reasons:

- Firstly, all the researchers interviewed consider the journal's reputation as the first criterion of where to publish regardless of whether it is OA.
- Secondly, when they publish OA, it is mainly to achieve a citation advantage hopefully and not so much to educate non-academic stakeholders.

- Thirdly, OA is very expensive for South African researchers who must pay from their research budgets because the Stellenbosch University OA fund is inadequate. Payment is also in South African Rand (ZAR), a much weaker currency than the Euro and the US Dollar, the currencies OA journals are priced in. Publication in paywall journals is free since the university subscribes to these journals.

From the interviewed winemakers' side, it was also not considered an effective boundary-spanning activity since even though readily available, almost no one knew what it was or read scientific articles frequently, let alone open access ones. Some intermediaries indicated that they read scientific articles on an ad hoc basis. Only one indicated that since open access publication of articles increased, his reading has increased. Open access can therefore not be considered a boundary-spanning activity of any prominence in the industry.

7.5.3 WINETECH TECHNICAL IN WINELAND MAGAZINE

Researchers reported publishing plain language articles in a practitioner magazine, *WineLand*. The technical division of *WineLand* magazine is managed by Winetech, which acts as an intermediary to facilitate the publication process. Winetech also acts as a gatekeeper to ensure that the information is presented clearly for practitioners to understand and assimilate. Even though none of the researchers received formal training to write plain language scientific articles, they proved to be very proficient in writing such articles. Most, however, only write these articles because Winetech contractually binds them to write popular articles about their Winetech-funded research. Very few occasionally submit articles about non-Winetech-funded research.

WineLand is an effective dissemination tool since the magazine is distributed to most winemakers in South Africa free of charge. The information is also freely available on the *WineLand* website. Information also remains available and serves as a knowledge reservoir for winemakers searching for information on the internet.

From the winemakers' and intermediaries' side, the printed magazine is handy to scan to see if anything is interesting and useful to them. With the printed magazine, they don't actively have to search for information. It arrives on their desk for them to page through. One can argue that the printed magazine is an important boundary-spanning tool that promotes accidental factual learning.

7.5.4 FACE-TO-FACE KNOWLEDGE TRANSFER

According to the literature, more frequent interactions help to develop shared values and norms and a relationship of trust. This eases communication and understanding and leads to more effective knowledge transfer (Iorio, Labory & Rentocchini, 2017).

Researchers reported utilising several face-to-face knowledge transfer channels to transfer and exchange knowledge with industry, i.e., conferences, seminars, workshops and short courses. However, these events do not happen frequently, nor do oenology researchers get invited to regularly talk at these events, except for the South African Society of Enology and Viticulture (SASEV) conference, which is an academic conference open for industry to attend. In this case, the presenters are predominantly academic researchers. Very few winemakers attend the conference. They find the information “too academic” and not yet in a phase where the information is useable.

Room for improvement exists with university-initiated short courses and workshops. One researcher specifically pointed out how surprised he was how little the DVO offered the SA wine industry in terms of its short course and workshop offerings. Since there have been so few of these events, winemakers could not express their views on them but indicated a high level of trust for such events hosted by the DVO.

Finally, some researchers reported informal ad hoc interactions with winemakers. They include providing chemical or sensory analysis of wines, giving advice on winemaking problems, being part of or being invited to partake in winemaker study groups, being on the boards of some of the cultivar associations and interacting while asking the industry to help with grape, juice or wine samples for research. Two researchers were quite active regarding ad hoc interactions with industry and well-known amongst winemakers when they were prompted to name who they knew and interacted with in the DVO. Another three researchers reported regularly interacting with industry, and winemakers were also aware or have interacted with these researchers. The other six researchers were largely “unknown” to the industry due to less frequent interaction, even though they most probably were their lecturers in some of the oenology undergraduate courses.

Even though all the researchers found interacting with the industry a positive learning experience, only five interacted regularly. For these five, ad hoc interactions are very effective boundary-spanning activities. They reported their interactions as insightful and enjoyable. The other researchers listed various reasons why they don’t interact more frequently. Ad hoc interactions are thus powerful boundary-spanning activities for some due to their research orientations, individual personalities and intrinsic motivations.

7.6 CONCLUDING RECOMMENDATIONS

Suppliers of oenological products and services and industry consultants are private companies and individuals that self-regulate their internal knowledge reservoirs. The recommendations in this section concentrate on the communities of oenology researchers and winemakers and the industry-funded intermediary, Winetech.

7.6.1 RECOMMENDATIONS FOR THE DEPARTMENT OF VITICULTURE AND OENOLOGY, STELLENBOSCH UNIVERSITY

The findings from the empirical study suggest that the most critical factor determining a researcher's propensity to engage in knowledge-related interactions with industry is their individual characteristics. All the researchers were exposed to the same national and organisational aspects, yet two researchers emerged as being the most visible in the industry. Some other researchers were motivated to engage more but experienced some individual constraints.

The faculty of AgriSciences and the management of the DVO should consider providing those motivated to engage with the SA wine industry with proper support in terms of training, administrative help and financial resources for knowledge transfer. Ideally, industry engagement and knowledge transfer should also be evaluated and rewarded adequately for those researchers choosing to have it as evaluative criteria. Care must be taken to ensure that the traditional scholarly roles of researchers, research and teaching, are not neglected. A possible practical approach would be to look at the research team's personalities, motivations and abilities and introduce a division of labour. This will help the university to fulfil its third mission whilst academic freedom is respected.

Researchers who supervise post-graduate students should motivate them to write plain language articles for *Winetech Technical*, even if Winetech did not fund their research. Assistance can be provided by either themselves or Winetech personnel on how to write for an industry audience. *WineLand* magazine remunerates authors of articles. One oenology researcher already instructs his students to practice writing plain language articles, one of which has successfully been published in the magazine. If knowledge transfer training becomes available at the university, researchers and their students should consider attending such training. The training should ideally be offered in one-day or half-day sessions. All researchers and students at Stellenbosch University can significantly benefit from such knowledge transfer/science communication training, especially those in applied fields.

The DVO could investigate the possibility of more workshops with intermediaries such as Winetech and suppliers of oenological products and services. The events must offer a combination of factual and practical information, be interactive, and include wine tastings to demonstrate research or practical trial results. Such workshops must be entirely based on industry needs. These workshops should also be taken to the winemakers in their areas and be small groups instead of lecture-style big groups.

Finally, researchers interested in submitting concept proposals for research could consult with suppliers of products and services to obtain insights into what might be useful to the industry. Suppliers are in frequent contact with winemakers and are aware of winemakers' problems and needs. Researchers can also contact Winetech employees to assist them with who to contact in the industry to serve as a sounding board for ideas.

7.6.2 RECOMMENDATIONS FOR WINETECH

Winetech should consider the following actions:

- Including more practical results (obtained via face-to-face visits with winemakers) combined with scientific facts in the articles it publishes in *Winetech Technical.*
- Increasing its *Winetech Scan* database size to reach more winemakers and intermediaries.
- Consider printing some of its written resources since it promotes accidental learning.
- Consider publishing some oenology-related books due to the high trust winemakers place in such books.
- Including more well-qualified suppliers of oenological products and services on its research evaluation committees for their informed input and to help disseminate knowledge created through Winetech-funded research.
- Including more facts-driven winemakers (especially millennials) that are very interested in research on its research evaluation committees.
- Support interactive knowledge transfer events such as cultivar association meetings and winemaker study groups where the topics of conversation are determined or approved by the winemakers.

7.6.3 RECOMMENDATIONS FOR WINEMAKERS

Knowledge uptake and utilisation is a very personal choice and, as indicated by the results from the study, can be influenced by various factors. However, winery leadership should ideally encourage self-directed learning by its employees and make every effort to optimise people development in its environment. Young winemakers may possess adequate factual knowledge due to their recent formal training but can lack the knowledge on how to apply these facts in practical settings. Interactions with suppliers and attending industry knowledge transfer events should be encouraged. Leadership should ensure practitioner magazines are distributed to all winemakers at the winery and that they are aware of the *Winetech Scan* email newsletter. Winemakers and intermediaries are also advised to become members of the South African Wine Industry Professional Body (SAWIPB), which contains competency frameworks for secondary production (winemaking) and learning opportunities to obtain these competencies.

7.6.4 RECOMMENDATIONS FOR FUTURE RESEARCH

This study addressed research needs identified by Perkmann et al. (2021) in their academic engagement framework. It makes a novel contribution to the academic engagement and knowledge transfer literature by combining data from academics, practitioners and intermediaries within the same knowledge network. Such studies are very uncommon. The study was also conducted in a developing country, whereas most studies in the knowledge transfer field are from developed economies. Three types of studies explore academic researchers' knowledge-related interactions with non-academic audiences, i.e., the science communication literature (researchers and the general public), the technology transfer literature (researchers engaging in patenting, licensing and commercial activities with industries or the public) and academic engagement and knowledge transfer literature (researchers engaging in non-commercial knowledge-related interactions with industry practitioners). Of the three types of literature the last one, academic engagement and knowledge transfer, is the least well researched and therefore provide ample research opportunities.

More studies like the current one are encouraged since the academic engagement literature focuses mainly on academia's perspective. Obtaining more practitioner-focused or combining academia and practitioner studies could prove valuable for applied research domains. The influence of university evaluation systems on researchers' propensity to engage with industry is also scarce. Studies exist in the science communication and technology transfer literature, but a gap exists in the knowledge transfer literature. Finally, in the South African context, research addressing the social impact of universities relating to knowledge transfer to agricultural practitioners can be of great value.

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APPENDIX 1: PERMISSION TO BE INTERVIEWED EMAIL TO RESEARCHERS 2019

From: O'Kennedy, Karien [email address]
Sent: Wednesday, 04 September 2019 12:27 PM
To: [researcher email]
Subject: Karien PhD - Invitation to interview
Importance: High

Dear [researcher name],

I would like to invite you to participate in a research project entitled "Wine scientists and winemakers as two communities: Bridging the gap through boundary spanning activities."

Please take some time to read the information presented here, which will explain the details of this project and contact me if you require further explanation or clarification of any aspect of the study. Also, your participation is **entirely voluntary,** and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part. The study has ethical clearance and institutional permission to interview SU personnel (can be provided on request).

The proposed study:

Scientists and practitioners are often described in the literature as two communities with conflicting values, reward systems and languages. In this study, these two worlds as they relate to Oenology researchers within the Department of Viticulture and Oenology (DVO), Stellenbosch University and South African (SA) winemakers will be investigated. The study will be guided by four research questions:

(1) What are the current internal operations and external relations of science?
(2) What are the internal operations and external relations of SA wine scientists, specifically?
(3) What are the factors that characterise the institutional landscape and information-seeking behaviours of SA winemakers and intermediaries? Then, as a sub-question: What role do these intermediaries play in facilitating the knowledge exchange between the communities of wine scientists and winemakers?
(4) Based on research questions 1 to 3, what can be concluded about identified boundary-spanning activities as ways to strengthen knowledge exchange and practice adoption within the SA wine industry? (Evidence-based contribution to a boundary spanning strategy for knowledge exchange between wine scientists and winemakers.)

This is a low-risk exploratory study. Interviews will be in the form of semi-structured questionnaires (attached) that will be voice recorded and transcribed. You can choose not to answer certain questions and remain in the study. All data will be treated confidentially and will be password protected and safely backed up on a cloud service.

By partaking in the study, participants will provide the funder of this study with a clearer understanding of the institutional expectations of academic researchers. This will allow the funder to make more informed decisions in terms of expectations from SU researchers when allocating research funding.

Please provide me with a proposed date, time and venue that will suit you best. The interview should not last more than 40 minutes. The consent form to take part in the study is attached and can be signed before the interview.

If you have any questions or concerns about the research, please feel free to contact me or my supervisor.

Karien O'Kennedy
CREST PhD candidate – Science and Technology Studies
[contact details]

Prof. Nelius Boshoff
CREST Associate Professor in Science and Technology Studies
[contact details]

APPENDIX 2: DECLARATION OF CONSENT TO PARTICIPATE IN RESEARCH (RESEARCHERS) 2019

UNIVERSITEIT•STELLENBOSCH•UNIVERSITY
jou kennisvennoot • your knowledge partner

STELLENBOSCH UNIVERSITY
CONSENT TO PARTICIPATE IN RESEARCH

Dear…

My name is Karien O'Kennedy and I am a PhD student. I would like to invite you to participate in a research project entitled "Wine scientists and winemakers as two communities: Bridging the gap through boundary spanning activities."

Please take some time to read the information presented here, which will explain the details of this project and contact me if you require further explanation or clarification of any aspect of the study. Also, your participation is **entirely voluntary,** and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part.

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(3) What are the factors that characterise the institutional landscape and information-seeking behaviours of SA winemakers and intermediaries? Then, as a sub-question: What role do these intermediaries play in facilitating the knowledge exchange between the communities of wine scientists and winemakers?
(4) Based on research questions 1 to 3, what can be concluded about identified boundary-spanning activities as ways to strengthen knowledge exchange and practice adoption within the SA wine industry? (Evidence-based contribution to a boundary spanning strategy for knowledge exchange between wine scientists and winemakers.)

This is a low-risk exploratory study. Interviews will be in the form of semi-structured questionnaires that will be voice recorded and transcribed. You can choose not to answer certain questions and remain in the study. All data will be treated confidentially and will be password protected and safely backed up on a cloud service.

By partaking in the study participants will provide the funder of this study with a clearer understanding of the institutional expectations of academic researchers. This will allow the funder to make more informed decisions in terms of expectations from SU researchers when allocating research funding.

If you have any questions or concerns about the research, please feel free to contact me or my supervisor.

Karien O'Kennedy
[contact details]

Prof Nelius Boshoff
[contact details]

RIGHTS OF RESEARCH PARTICIPANTS: You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights, or remedies because of your participation in this research study. If you have questions regarding your rights as a research participant, contact Ms Maléne Fouché [contact details] at the Division for Research Development.
You have the right to receive a copy of the Information and Consent form.

If you are willing to participate in this study, please sign the attached Declaration of Consent.

DECLARATION BY PARTICIPANT

By signing below, I …………………………………………………. agree to take part in a research study entitled: "Wine scientists and winemakers: Bridging the gap through boundary spanning activities," and conducted by Karien O'Kennedy.

I declare that:

- I have read the attached information leaflet and it is written in a language with which I am fluent and comfortable.
- I have had a chance to ask questions and all my questions have been adequately answered.
- I understand that taking part in this study is **voluntary** and I have not been pressurised to take part.
- I may choose to leave the study at any time and will not be penalised or prejudiced in any way.
- I may be asked to leave the study before it has finished if the researcher feels it is in my best interests, or if I do not follow the study plan, as agreed to.
- All issues related to privacy and the confidentiality and use of the information I provide have been explained to my satisfaction.

Signed on ……………………..

…………………………………………………………………..

Signature of participant

SIGNATURE OF INVESTIGATOR

I declare that I explained the information given in this document to ___________________ [*name of the participant]* [*He*/she] was encouraged and given ample time to ask me any questions. This conversation was conducted in [*Afrikaans/*English/*Xhosa/*Other*] and [*no translator was used/this conversation was translated into* ___________ by ________________________].

____ _______________

Signature of Investigator **Date**

APPENDIX 3: OENOLOGY RESEARCHER INTERVIEW SCHEDULE 2019

Unit of analysis:	Oenology researchers at Stellenbosch University
Research objective:	Exploratory
Overall research design:	A case study
Research methodology:	Qualitative
Research method:	Semi-structured interviews of purposely selected individuals (in this context, all Oenology academics and researchers in the Department of Viticulture and Oenology will be invited to participate, n=11)

Research and Funding

- What is your research about?
- Who funds your research?
- How important is an NRF rating to you?
- What do your funders expect from you in terms of the type of research you do?
- How do your funders expect you to disseminate your research results?

Teaching and student supervision

- What are your current teaching responsibilities?
- How would you describe your teaching load?
- What does your student supervision entail?

Industry engagement / Knowledge transfer

- Who do you interact with in your research?
- How useful is your research to the wine industry?
- How do you engage with the industry?
- What are your motivations for engaging with the industry?
- What are the main constraints preventing you, in your specific situation, from engaging more with the industry?
- Does industry engagement benefit you?
- Does industry engagement disadvantage you in any way?
- Describe to me how you personally balance the demand for both excellence and relevance in your career.

Organisational factors

- What are your university's expectations in terms of the type of research that you do?
- What are your university's expectations in terms of your research dissemination?
- Describe the promotional (evaluation) guidelines relevant to you.
- Is your department dependent on industry funding?
- What do you define as knowledge transfer?
- How does your university/faculty/department incentivise you for engaging in knowledge transfer activities with the industry?
- How does the industry incentivise you for knowledge transfer activities?
- How do you access funds (if needed) for knowledge transfer activities?
- What type of training have you received in terms of media interactions, popular article writing, presentation skills, social media, etc?
- What types of knowledge transfer training does Stellenbosch University offer for academics, researchers and students?
- In your opinion, what can the Faculty of Agrisciences and/or SU do to enhance knowledge transfer/exchange activities amongst researchers in applied sciences (Such as Oenology)?

Demographics

In which age group do you fall?

- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 – 70

What is your academic status?

- Researcher
- Academic
- Associate professor (academic)
- Full professor (academic)
- Distinguished professor (academic)

APPENDIX 4: WINEMAKERS WEB SURVEY QUESTIONNAIRE 2019

Section A

1. In a typical year, what percentage of your working time do you spend on each of the following tasks? (Please ensure that the percentages total 100%.)

Time in the vineyard	……….%
Physical winemaking activities in the cellar (e.g., wine racking)	……….%
Managing winemaking activities (giving instructions / creating worksheets)	……….%
Winemaking-related admin (SAWIS, IPW, Wieta, ISO, etc.)	……….%
Wine marketing and wine sales activities (tastings, meeting with buyers, direct marketing, preparing and attending wine shows, journalist interaction, etc.)	……….%
Mentorship / self-directed learning	……….%
Other	……….%

2. In a typical week (harvest excluded), how regularly do you consult with sources (other than relying on your own personal knowledge) of the following types of information:

	Daily or almost daily	About three times a week	About twice a week	About once a week	Less than once a week	Never
Oenology	1	2	3	4	5	6
Viticulture	1	2	3	4	5	6
Wine sales/marketing	1	2	3	4	5	6

Section B

3. How often do you consult with the following people for new or existing winemaking (Oenology) information?

	About once a week	About once a month	About once every 3 months	About once every 6 months	About once a year	Less than once a year	Never
Local winemaking consultant(s)	1	2	3	4	5	6	7
International winemaking consultant(s)	1	2	3	4	5	6	7
Industry opinion leader/mentor	1	2	3	4	5	6	7
Winemaking colleagues at your own cellar	1	2	3	4	5	6	7
Winemakers in your area	1	2	3	4	5	6	7
Winemakers in other areas	1	2	3	4	5	6	7
Suppliers of oenological products/machinery	1	2	3	4	5	6	7
Winetech employees	1	2	3	4	5	6	7
Stellenbosch University researchers	1	2	3	4	5	6	7
Nietvoorbij researchers	1	2	3	4	5	6	7

Analytical laboratories' (e.g., Vinlab) personnel	1	2	3	4	5	6	7

4. How often do you make use of the following resources to obtain new or existing winemaking (Oenology) information?

	About once a week	About once a month	About once every 3 months	About once every 6 months	About once a year	Never
An Internet search of the topic (e.g., via Google)	1	2	3	4	5	7
Supplier/service provider websites	1	2	3	4	5	7
Supplier/service provider e-mails	1	2	3	4	5	7
Oenology textbooks	1	2	3	4	5	7
Webinars	1	2	3	4	5	7
International trade magazines (printed and online)	1	2	3	4	5	7
A printed copy of *Winetech Technical* in *WineLand* magazine	1	2	3	4	5	7
Online *Winetech Technical* on *WineLand* website	1	2	3	4	5	7
Annual *Winetech Technical Yearbook* -interactive pdf	1	2	3	4	5	7
Winetech Scan (e-mails or website)	1	2	3	4	5	7
Winetech final reports on research database	1	2	3	4	5	7
Facebook	1	2	3	4	5	7
Instagram	1	2	3	4	5	7
Twitter	1	2	3	4	5	7
Articles in the *South African Journal for Enology and Viticulture (SAJEV)*	1	2	3	4	5	7
Articles in other scientific journals	1	2	3	4	5	7
Oenology cell phone apps	1	2	3	4	5	7

5. On average how often do you attend the following events to obtain new or existing winemaking (Oenology) information?

	Four or more times a year	About three times a year	About twice a year	About once a year	Never
Winemaker study/tasting groups	1	2	3	4	5
Cultivar groups seminars	1	2	3	4	5
Supplier/service provider seminars	1	2	3	4	5
Stellenbosch University short courses (2 per year)	1	2	3	4	5
International vine and wine conferences	1	2	3	4	5

South African Society for Enology and Viticulture (SASEV) conference (1 per year)	1	2	3	4	5
SASEV workshops (2 per year)	1	2	3	4	5

6. How trustworthy (accuracy of wine science) do you consider/perceive the following resources even if you do not make use of them?

	Very trustworthy	Generally trustworthy	Sometimes not trustworthy	Definitely not trustworthy
Local winemaking consultant(s)	1	2	3	4
International winemaking consultant(s)	1	2	3	4
Industry opinion leader/mentor	1	2	3	4
Winemaking colleagues at your own cellar	1	2	3	4
Winemakers in your area	1	2	3	4
Winemakers in other areas	1	2	3	4
Suppliers of oenological products/machinery	1	2	3	4
Winetech employees	1	2	3	4
Stellenbosch University researchers	1	2	3	4
Nietvoorbij researchers	1	2	3	4
Analytical laboratories' (e.g., Vinlab) personnel	1	2	3	4
An Internet search of the topic (e.g., via Google)	1	2	3	4
Supplier/service provider websites	1	2	3	4
Supplier/service provider e-mails	1	2	3	4
Oenology textbooks	1	2	3	4
Webinars	1	2	3	4
International trade magazines (printed and online)	1	2	3	4
Articles published in *Winetech Technical* in *WineLand* magazine (printed and online)	1	2	3	4
Winetech Scan (e-mail) articles	1	2	3	4
Winetech final reports on research database	1	2	3	4
Facebook	1	2	3	4
Instagram	1	2	3	4
Twitter	1	2	3	4
Articles in *the South African Journal for Enology and Viticulture (SAJEV)*	1	2	3	4

Articles in other scientific journals	1	2	3	4
Winemaker study/tasting groups	1	2	3	4
Oenology cell phone apps	1	2	3	4
Cultivar groups seminars	1	2	3	4
Supplier/service provider seminars	1	2	3	4
Stellenbosch University short courses	1	2	3	4
International vine and wine conferences	1	2	3	4
South African Society for Enology and Viticulture (SASEV) conference	1	2	3	4
SASEV workshops	1	2	3	4

7. Indicate your level of agreement with the following statements:

	Strongly agree	Agree	Indifferent	Disagree	Strongly disagree
My current level of winemaking knowledge is enough for me.	1	2	3	4	5
I only look for information on winemaking when I have a specific question.	1	2	3	4	5
Talking to another winemaker if I need information is enough.	1	2	3	4	5
My management encourages me to gain more winemaking knowledge through various resources.	1	2	3	4	5
I am restricted in implementing new winemaking knowledge due to a more senior person at the winery being "set in his/her ways."	1	2	3	4	5
I gather new winemaking information only if I have time.	1	2	3	4	5
I focus more on obtaining marketing information than winemaking information.	1	2	3	4	5
I make the time to gather as much winemaking information as possible from various sources.	1	2	3	4	5
I focus more on obtaining viticulture information than winemaking information.	1	2	3	4	5
I divide my time equally between gaining new knowledge on winemaking, viticulture and marketing.	1	2	3	4	5
I am interested in the latest Oenology research at the Department of Viticulture and Oenology, SU.	1	2	3	4	5
I am interested in the latest international Oenology research.	1	2	3	4	5

8. When an (affordable) innovation that could be applicable to you becomes available, what do you normally do?

[Innovations can include new yeasts, new nutrients, new vegetable protein fining agents, Potassium polyaspartate for cold stabilisation, new winemaking techniques, etc.]

Immediately try out the innovation	1
Wait for someone else to first try out the innovation before doing so	2
Wait for various winemakers to try out the innovation before doing so	3
Wait for the majority of industry to try out the innovation before doing so	4
Cannot try it out because someone else at the organisation makes decisions about trialling innovations	5

9. How often do fellow winemakers ask you for advice?

At least once month	1
At least once in 3 months	2
At least once in 6 months	3
Never / almost never	4

Section C

10. Do you know any of the current Oenology researchers (academics, senior researchers, post-graduate students) at the Department of Viticulture and Oenology (DVO) at Stellenbosch University?

Yes	1
No	2

11. What connections do you have with DVO researchers? (Please select all that apply.)

One or more of the DVO researchers were my lectures at the DVO.	1
One or more of the DVO researchers presented at the industry days that I attended.	2
One or more of the DVO researchers have/had projects with Winetech and I am/was on a Winetech committee.	3
I contacted one or more of the DVO researchers in the past to help me with a winemaking-related issue.	4
I donated grapes/juice/wine for a research project of one or more of the DVO researchers.	5
I have been involved in formal sensory analysis of a research project of one or more of the DVO researchers.	6
I have helped to conceptualise a research project of one or more of the DVO researchers.	7
I have been involved with a research project of one or more of the DVO researchers (testing new products, processes, etc.)	8
One or more of the DVO researchers and I attend the same study group.	9
One or more of the DVO researchers and I socialise together.	10
Other (Specify: ……………………………………………………………………………………………………….)	

Section D

12. What is your <u>HIGHEST OENOLOGY RELATED</u> qualification?

No official Oenology-related qualification	1
SKOP (Wine Training South Africa (Please specify level: ……………………………………………………………………)	2
Garagiste winemaking short course (Stellenbosch University)	3
National Diploma in Viticulture and Oenology (CPUT)	4
Diploma in Cellar Technology (Elsenburg)	5

BAgric in Cellar Technology (Elsenburg)	6
BAgric in Cellar Management (Elsenburg)	7
BScAgric Viticulture and Oenology (Stellenbosch University)	8
MScAgric Oenology (Stellenbosch University)	9
PhD Oenology (Stellenbosch University)	10
HonsBSc Wine Biotechnology (Stellenbosch University)	11
MSc Wine Biotechnology (Stellenbosch University)	12
PhD Wine Biotechnology (Stellenbosch University)	13
International qualification(s) (Please specify: ....)	14

13. Other winemaking or viticulture-related qualifications not listed above (viticulture degrees, short courses, Cape Wine Academy, etc.)
    ....

14. Other accredited qualifications not necessarily related to winemaking (e.g., university short courses, other diplomas, degrees, MBA, etc.)
    ....

15. How old are you?

20 – 29 years	1
30 – 39 years	2
40 – 49 years	3
50 – 59 years	4
60 – 69 years	5
70 + years	6

16. Are you male of female?

Male	
Female	

17. Which one of the following best describes your job title?

Assistant winemaker	1
Winemaker (cellar has only one winemaker)	2
Senior/head winemaker	3
Production manager	4
General manager/winemaker	5
Other (Please specify: ....)	

18. Which of the following best describes the winery where you currently work?

Estate Winery	1
Private Cellar	2
Producer Cellar	3
Producing Wholesaler	4
Other (Specify: ....)	5

19. In what wine region/district/ward is the winery where you spend most of your time located?

Breedekloof	1
Constantia	2
Darling	3

Durbanville	4
Elgin	5
Elim	6
Franschhoek	7
Klein Karoo	8
Northern Cape	9
Olifants River	10
Overberg	11
Paarl	12
Robertson	13
Stellenbosch	14
Swartland	15
Tulbagh	16
Walker Bay	17
Wellington	18
Worcester	19
Other (Please specify: ………………………………………………)	

20. Completion of the questionnaire is anonymous. However, I would like to follow up on some of the interesting responses by means of interviews. If you would be willing to talk in more depth about your winemaking, please provide your contact details in the spaces below. (NB: provision of these details is voluntary and not compulsory. If you prefer not to provide any details, please leave the spaces blank.)

Name:……………………………………………………….

E-mail:………………………………………………………

Telephone number:…………………………………

APPENDIX 5: WINETECH PERMISSION TO USE DATABASE AND EMAIL PROGRAMME

6 August 2019

Permission to distribute research survey

I hereby grant permission to Karien O'Kennedy, a permanent employee at Winetech, to distribute her proposed research survey amongst winemakers on the Winetech e-mail database. The survey is in fulfilment of Karien O'Kennedy's own academic research. The results of the survey are of great interest to Winetech, hence the permission to use Winetech winemaker contact details.

Research project number: CREST-2019-9508

Research project title: Wine scientists and winemakers as two communities: Bridging the gap through boundary spanning activities

Feel free to contact me if there are any questions.

Kind regards

Gerard Martin

Executive Manager

APPENDIX 6: EMAIL TO WINEMAKERS TO PARTICIPATE IN RESEARCH (WEB SURVEY) 2019

Dear winemaker,

My name is Karien O'Kennedy, a student at CREST (Centre for Research on Evaluation, Science and Technology), and I would like to invite you to take part in a survey, the results of which will contribute to a research project to complete my PhD.

Please take some time to read the information presented here, which will explain the details of this project.

Your participation is entirely voluntary, and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part.

The purpose of this study is to determine the information-seeking behaviours of South African winemakers. Results from this study will inform industry knowledge transfer role players on which information resources are the most popular and potentially the most effective for the transfer of new knowledge and technologies.

The questionnaire will take approximately 15 minutes to complete and will contain a combination of questions covering winemaking information sources currently available, as well as questions related to Oenology research.

RIGHTS OF RESEARCH PARTICIPANTS:

You have the right to decline to answer any questions and you can exit the survey at any time without giving a reason. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research participant, contact Ms Maléne Fouché [contact details] at the Division for Research Development.

If you are willing to participate, please click on this link to access the survey: [link to be included here]. This will open your web browser and take you directly to the questionnaire, which you can then complete and submit online. **By clicking on this link, you confirm that you have read and understood the information provided above and that you agree to take part in this survey.** The closing date for participation is [date to be included here].

Your information and response to the survey will be protected by the anonymity of this survey method used.

If you have any questions or concerns about the research, please feel free to contact me, Karien O'Kennedy, [contact details] or my Supervisor, Prof. Nelius Boshoff, [contact details].

To save a copy of this text, copy and paste it into a Word document and then save.

APPENDIX 7: INTERVIEW EMAIL TO WINEMAKERS AND INTERMEDIARIES

Dear [name of winemaker or intermediary], thank you for your willingness to participate in my research study. You can just click on the link below at the allocated time and I will admit you to the meeting. Please note that the interview will be recorded and by joining the meeting you agree to the recording. Attached you will find the proposed interview schedule as well as the consent form that you must sign and return to me before the interview commences.

Kind regards

Karien

Karien O'Kennedy | M.Sc.

PhD student: Centre for Research on Evaluation, Science and Technology (CREST)

Universiteit | iYunivesithi | Stellenbosch | University

e: [email] | **t:** [mobile number]

Microsoft Teams meeting

Join on your computer or mobile app

Click here to join the meeting

Join with a video conferencing device

529319312@t.plcm.vc

Video Conference ID: 128 625 384 2

Alternate VTC dialling instructions

Learn More | Meeting options

APPENDIX 8: WINEMAKER INTERVIEW SCHEDULE 2020

Unit of analysis:	South African winemakers
Research objective:	Exploratory
Overall research design:	A case study
Research methodology:	Qualitative
Research method:	Semi-structured interviews of purposefully selected individuals (n=20)

General

- How long have you been a winemaker? (Prompt: do you have international experience?)
- What are your current responsibilities and how have these changed over time? (If marketing is mentioned, ask how it has influenced winemaking responsibilities and knowledge-seeking activities).

Knowledge resources

- How do you currently obtain new (to you) winemaking-related knowledge?
- Of these sources you obtain new knowledge from, what are your preferred sources and why? (Prompt: How is social media used in the industry and is there a place for it in knowledge transfer?)
- What resources have you used in the past but stopped using and why?
- How can resources be improved to increase your knowledge uptake? (Prompt: SASEV conference, SU short courses, SU workshops, researcher presentations, Industry bodies, suppliers)

Finding a solution to a challenge

Suppose a major wine buyer contacts you and asks you to produce a wine style you have never produced before (vegan, natural, organic, low alcohol or SO_2-free wine). Describe to me the process you will follow to obtain information on how to produce such wines.

Have you had any other winemaking challenges recently that you needed to obtain information on how to overcome? Describe to me the process you followed.

Innovation

- Name one example of a recent innovation that you have implemented in the cellar. (Prompt: new products, new processes, new equipment…).
- Where did you hear about this innovation? (If a supplier is mentioned ask if they trust their supplier and what they base their trust on.)

Academic research

- What type of wine-related academic research does or would interest you?
- How important is it (to you) that wine-related academic research must be conducted in South Africa? Please explain your answer.
- How would you like to learn more about wine-related academic research?
- Do you ever read scientific articles? (Why not? Open access articles?)
- Are you familiar with some of the research areas at the Department of Viticulture and Oenology (DVO)? (Prompt: Name some researchers. Ask why they know some researchers better than others).
- In what ways do you think winemakers can contribute to research projects? (Prompt: Providing researchers with practical advice in terms of their projects, providing juice/wine, providing tasting expertise).
- The DVO researchers would like to have a closer relationship with the industry. What do you suggest they do?
- Do you think the newly established South African Wine Industry Professional Body (SAWIPB), where practitioners can earn CPD points for continuous learning activities, will enhance knowledge uptake amongst winemakers?

APPENDIX 9: INTERMEDIARY INTERVIEW SCHEDULE 2020

Unit of analysis:	South African (winemaking) intermediaries
Research objective:	Exploratory
Overall research design:	A case study
Research methodology:	Qualitative
Research method:	Semi-structured interviews of purposefully selected individuals (n=10)

General

- What are your current responsibilities and how has it changed over time?
- How long have you worked as an intermediary in the SA wine industry?
- What qualifications and experiences contributed to your current position?

Winemakers

- When do winemakers normally contact you for advice?
- What type of problems/challenges do they experience? (Prompt: in your opinion what are the most common causes of their problems?)
- How do you go about finding a solution?
- How do they respond to the advice/solution your offer?
- What factors respectively prevent and facilitate their implementation of your advice/solution?
- Do they sometimes implement your advice/solution differently than you intended?
- Do they have habits/beliefs that are difficult to change?
- If you must categorise winemakers into different groups according to their technical and practical expertise, what would your groups look like? (Probe: what are the decisive characteristics of each group?)
- How can knowledge resources be improved to enhance knowledge uptake by winemakers? (Prompt: SASEV conference, SU short courses, SU workshops, researcher presentations, Industry bodies, suppliers)

Knowledge resources

- How do you currently obtain new (to you) winemaking-related knowledge?
- Of these sources you obtain new knowledge from, what are your preferred sources and why?
- How regularly do you read scientific articles? (Prompt: Open access articles?)

- What resources have you used in the past but stopped using and why?
- How can resources be improved to increase your knowledge uptake?

Academic research

- In your opinion, what type of wine-related academic research would benefit the SA wine industry?
- How important is it (to you) that wine-related academic research must be conducted in South Africa? Please explain your answer.
- How would you describe your relationship with DVO researchers?
- In what ways do you think intermediaries can contribute to research projects?
- How would you describe winemakers' relationship with DVO researchers?
- In what ways do you think winemakers can contribute to research projects? (Prompt: Providing researchers with practical advice in terms of their projects, providing juice/wine, providing tasting expertise).
- The DVO researchers would like to have a closer relationship with the industry. What do you suggest they do?
- Do you think the newly established South African Wine Industry Professional Body (SAWIPB), where practitioners can earn CPD points for continuous learning activities, will enhance knowledge uptake amongst winemakers?