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Organisational preparedness for academic entrepreneurship: a case of a science council and universities in South Africa

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A research report submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Management in Entrepreneurship and New Venture Creation

Johannesburg, 2018

ABSTRACT

This paper investigated organisational preparedness for academic entrepreneurship post the promulgation of Intellectual Property Rights from Publicly Financed Research and Development Act (IPR-PFRD) in 2008. This study sought to understand whether strategic renewal in universities and research organisations accommodates the mission of academic entrepreneurship.

Academic entrepreneurship mostly takes place in an environment that facilitates commercialisation of research. Universities' first mission is education, followed by research and development. For commercialisation to be successful there has to be a change in the environment, such as a new strategy to create a culture and climate that is conducive for commercialisation.

Through academic entrepreneurship, universities and research organisations have a crucial role to play in the South African economy. This research study employed strategic renewal constructs; top management support, time allocation and rewards for academic entrepreneurship and academic entrepreneurship constructs; licences and start-ups to test the relationship between the two variables.

The hypothesis was tested by analysing the data that was collected at two universities and a science council. The results suggested a positive relationship between academic entrepreneurship and rewards for academic entrepreneurship and no relationship between top management support and time allocation, even though these have been shown in literature to have an effect on academic entrepreneurship.

This study is the first of its kind to use the Corporate Entrepreneurship Assessment Index to test the relationship between organisational preparedness and academic entrepreneurship in South Africa. As such, it advances the body of literature on academic entrepreneurship in South Africa by looking at the environment climate and culture that enables academic entrepreneurship.

DECLARATION

I, Siyanda Gamata, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Management in Entrepreneurship and New Venture Creation in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Siyanda Gamata

Signed at ……

On the …….. day of …… 2018

DEDICATION

To my late dad, Mbulelo Gamata, and my late sister, Asanda Gamata, you are forever in my heart.

To Iminathi and Linamandla, I will always love you.

ACKNOWLEDGEMENTS

I thank the Almighty God for the strength and courage He has given me to pursue this degree. I never would have made it without you.

To my supervisor, Prof Boris Urban, thank you for the guidance and support.

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To my study partner, Queen Ndlovu, I can never thank you enough for how you have impacted my life within such a short space of time. From the late nights, tears and laughter were shared. Thank you for being the best I could ever ask for! This is just the beginning.

To my family, thank you for your prayers and support. To my friends and everyone who supported me throughout this journey; thank you and may the good Lord be with you always.

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CHAPTER 1. Introduction

1.1 Purpose of the study

The purpose of this research is to assess the organisational preparedness for academic entrepreneurship, focusing on organisational factors that are supportive of entrepreneurship and innovation with specific focus on a science council and universities in South Africa.

1.2 Context of the study

There has been a growing need to develop entrepreneurial activities at Higher Education Institutions for economic and social development (Allessandrini, Klose, & Pepper, 2013). Universities' primary mission has been education and research (Meija, 1998). This trend of exploiting Research and Development (R&D) from universities began with the United States of America promulgating the Bayh-Dole Act in 1980. This Act governs intellectual property from government funded institutions (Rothaermel, Agung, & Jiang, 2007). The promulgation of the Bayh Dole Act allowed government to exploit research output through commercialisation and this resulted in an increased technology growth in United States (Kim, 2010).

Under the Bayh Dole Act, universities owned and managed their intellectual property which gave a greater flexibility in engaging with industry to facilitate economic development and entrepreneurial activity (Phan & Seigel, 2006).

Similar policies in Europe were implemented and these countries experienced a remarkable increase in university entrepreneurship, scientific capacity and rise in venture capital resources (Rothaermel, Agung, & Jiang, 2007). For researchers in Europe, the option of taking equity in the start-ups or royalties made technology transfer desirable (Wright, Birley, & Mosey, 2004).

In response to this trend and growing need, South Africa has embraced and supported the process of improving and the exploitation of the research emanating from government funded research institutions in an attempt to move South Africa to a knowledge driven economy with innovation at the forefront (DST, 2007).

In South Africa, the Intellectual Property Rights on Publicly Financed Research and Development (IPR PFRD) Act No 51 was promulgated in 2010 as part of this strategy to regulate the use of Intellectual Property Rights emanating from government funded institutions (DST, 2009/10). As part of the Act, Higher Education Institutions (HEI) and Science Councils had to establish Technology Transfer Offices (TTO) to be responsible for identification, protection and commercialisation of innovations, (RSA, Intellectual Property Rights from Publicly Financed Research and Development Act, Number 51, 2008).

South African universities were motivated to engage in commercialisation as a result of a push by government to exploit research outcomes. Universities were also motivated to diffuse technologies to secure additional research and development funding (Nyatlo, 2015).

In 2015, a strategy document from the Department of Science and Technology reported that 682 invention disclosures had been made since the IPR act was promulgated in 2010, and 648 were still active. Out of the 648 active technology disclosed in these institutions, 5% had enforceable rights and 5% were licensed or commercialised (DST, 2015).

The South African Government's National Research and Development Strategy identified the "valley of death" that bars research output to be commercialised as an "innovation chasm". To address the gap, an Act was effected to establish a Technology Innovation Agency that will stimulate and intensify development and exploitation of innovation and inventions that will lead to economic growth and improve the lives of South Africans (Nyatlo, 2015).

As part of the IPR Act, institutions had to establish a technology transfer office which Wolson (2007) argued, plays a crucial role in bridging the "innovation chasm" by addressing some of the factors within the institutions that inhibit commercialisation.

From a policy perspective, the government has effected policies that seek to encourage exploitation of research output. This study aims to investigate the internal environment within which these technology transfer offices and academic entrepreneurship ought to operate to determine if the culture and climate has changed to encourage academic entrepreneurship. Nyatlo (2015) postulates that a technology transfer office's success depends on the beneficial exploitation, industrial application and absorption of the IP into the market, but all of that depends on the environment in which the technology transfer is operating.

With the growing need to commercialise research output from universities, there is a need to also examine the environment within the institutions to see whether it facilitates a commercialisation mission. One can argue that our IPR Act is nascent compared to other countries, but there is room for improvement.

This study focuses on the science council and universities in Gauteng Province of South Africa. These institutions fall under the institutions whose intellectual Property is governed by the IPR Act. The aim of the study is to look at the organisational preparedness for academic entrepreneurship in order to promote the third mission of commercialisation.

1.3 Problem statement

1.3.1 *Main problem*

South Africa was ranked 79 out of 128 countries on innovation output by the Global Innovation Index while it was ranked 49 out of 128 on the Innovation Input (Global Innovation Index, 2015). South Africa needs to increase the innovation output, and Higher Education Institutions and Science Councils play a crucial role. Intellectual

Property Rights (IPR) Act, National Intellectual Property Management Office and Technology Innovation Agencies support structures to the Technology Transfer Offices in these institutions to assist in fulfilling their mandate.

These structures are outside the universities, and it would be important to see what structures, policies, activities and environment is promoted in the research institution to create an enabling environment for innovation and entrepreneurship.

Allessandrini, Klose , and Pepper (2013) argue that some of the key success factors of a technology transfer are; policies and work environment that promotes entrepreneurship and innovation, support from institutional top management and clear policies. Furthermore, Huyghe and Knockaert (2014) argue that the institutional context of the research can either facilitate or impede academic entrepreneurship, above and beyond their individual-related characteristics.

With the promulgation of the IPR Act in 2008, universities and science councils need to accommodate this in their strategy. There has been no study that assessed this organisational preparedness, looking specifically on strategic renewal of these institutions to accommodate the third mission.

The main problem of the study is thus stated as: to assess the organisations' preparedness for academic entrepreneurship looking at the culture and climate whether it promotes academic entrepreneurship or not.

1.3.2 *Sub-problems*

Sub problem 1*:* Assess top management support for academic entrepreneurship

Sub problem 2: Assess if the organisation rewards academic entrepreneurship

Sub problem 3: Assess researcher's time allocation for academic entrepreneurship

1.4 Significance of the study

Since the promulgation of the IPR Act and the establishment of various institutions to support the objectives of the Act, there has not been much research on the organisational culture and climate for academic entrepreneurship in Higher Education Institutions (HEI) in South Africa. HEI's core business in academic and research councils is research and development. The IPR Act brought the element of commercialisation to it.

The technology transfer offices play the role of creating awareness of the intellectual property identification, protection and assist in the commercialisation process. It is therefore important to not only focus on their role, but to assess the organisation as a whole to see if it promotes academic entrepreneurship by looking at strategy renewal.

The study hopes to contribute to the body of knowledge on organisational preparedness for academic entrepreneurship by gathering data and reviewing the literature. Data from this study may give guidance to technology transfer practitioners, NIPMO, the Department of Science and Technology on what are enablers and/or barriers to academic entrepreneurship.

1.5 Delimitations of the study

- The research study focuses on research institutions governed by the Intellectual Property Rights from Publicly Financed Research and Development Act No. 51 of 2008.

1.6 Definition of terms

Technology transfer is defined according to the AUTM definition as a process of transferring scientific results from one institution to another for further development and commercialisation (AUTM, 2014).

Academic entrepreneurship : This study is based on the Abreu and Grinevich (2013,p. 408) definition of Academic Entrepreneurship which is defined "as any activity that occurs beyond the traditional roles of teaching and research, which is innovative and comprises an element of risk and may lead to commercialisation".

University is used as shorthand for publicly funded research institutions and the Science Council throughout the study.

Commercialisation is defined as "the process of moving scientific or technological developments into saleable products" (Nelson, 2014, p.1144).

Technology transfer is defined as "as a process of commercialising intellectual property from academic research through licensing or start-up company" (Friedman & Silberman, 2003, p.18).

1.7 Assumptions

There are several assumptions made in this study;

- Participants found time to respond to the online survey;
- Participants comprehended and answered the questions to the best of their ability;
- Participants were honest and genuine in their responses to questions asked;
- Participants might have felt uncomfortable to disclose certain information or might have chosen to discontinue with the interview at any given time;
- The number of participants surveyed were sufficient to obtain adequate data.

CHAPTER 2. LITERATURE REVIEW

2.1 Introduction

The section of literature review looks at the background of entrepreneurship globally and also the South African context. A discussion of Academic entrepreneurship literature, followed by the status of academic literature in South Africa, is reviewed in Section 2.3.1 and 2.3.2. The literature on Technology Transfer offices in South Africa, in particular, is discussed. Section 2.3.4 reviews the Organisational culture and climate literature which is followed by a thorough discussion of the Top Management support and mission, rewards and time allocation discussions. Lastly, this chapter also presents the hypotheses of this study, followed by the conceptual framework.

2.2 Background

The theoretical discussion of this study is built on the concepts of academic entrepreneurship and organisational culture and climate. Abreu and Grinevich (2013) describe academic entrepreneurship as "*any activity that occurs beyond the traditional academic roles of teaching and/or research, is innovative, carries an element of risk, and leads to financial rewards for the individual academic or his/her institution*".

2.3 Entrepreneurship

Research has shown a rising interest on the entrepreneurship role as a result of shift in the economies from "managed economies to entrepreneurial economies"; that are driven by innovation, knowledge and flexible structures (Acs & Stough, 2008; Semerci & Cimen, 2017). This transition from managed "economies to entrepreneurial economies" has had an influence on economic growth (Semerci & Cimen, 2017).

Researchers have articulated that the most significant benefit of the transition has been the increase in the creation of employment, an opportunity pool, knowledge spill overs and fostering (Semerci & Cimen, 2017).

This was confirmed by a statistical study done by Stephens and Partridge (2011) which showed a positive relationship between economic growth and entrepreneurship in lagging regions. Arguing for inclusion of entrepreneurial activities to facilitate economic growth, Michelacci (2003) posits that an increase in research activities resource allocation is not sufficient for economic growth, but that transformation of research by entrepreneurs into economic activities and facilitation of knowledge spill overs may impact economic growth.

Semerci and Cimen (2017) emphasised that transitioning from managed economies to entrepreneurial economies varies from one country to another and is informed by the level of individualism and environmental factors. These individualistic factors include personality, psychological and environmental factors, and political, legal, social, financial and industrial aspects.

Looking at the definition of entrepreneurship, a number of scholars have defined entrepreneurship expanding from the Schumpeter (1934) and Kirzer (1973) works. Some scholars view entrepreneurship differently with some agreeing that entrepreneurship is an activity that comprises an innovative way of organising resources to exploit an opportunity, markets, introduce new goods and risk-taking as the outcome of the process is uncertain.

There are several definitions of entrepreneurship. Zimmer and Scarborough (2004) define entrepreneurship as the ability and proclivity to organise, develop and manage a business that has a potential to make a profit while it has manageable risks. In academia, the academic entrepreneur refers to a researcher who turns ideas generated in institutions into marketable products or services (Meyers 2003).

Shane's (2003) approach to the Entrepreneurship process, as reviewed by Moroz and Hindle (2012), is based on the nexus of individual and opportunity. The entrepreneurship framework by Shane (2003) looks at the existence of the opportunity that may be exploited for profit, willingness to exploit the opportunity, propensity to take the risk, organising resources needed to exploit the opportunity and have some form of innovation.

The picture below summarises the entrepreneurship process explained above through Shane's model.

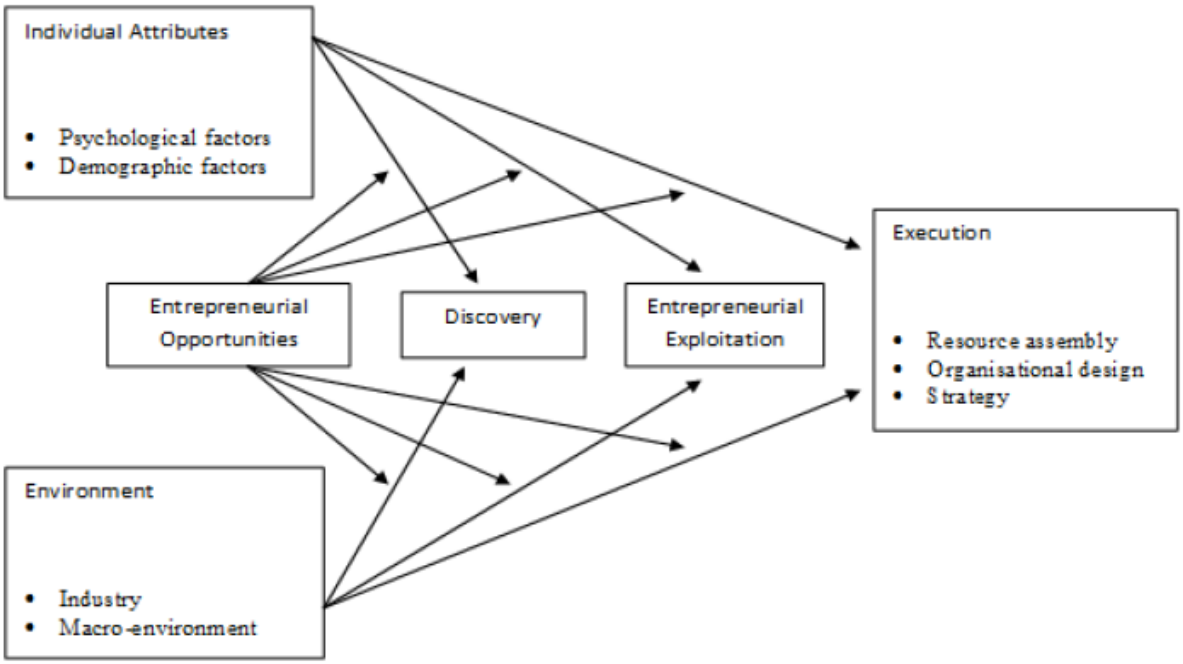

Figure 1. The individual-opportunity nexus framework (Shane, 2003:11).

Figure 1: The individual-opportunity nexus framework (Shane, 2003, p. 11) Source: Moroz and Hindle (2012)

An interesting view of entrepreneurship by Audretsch and Caiazza (2016) defines entrepreneurship as the process of creating profits from an uncertain environment from a combination of novel and valuable knowledge. In light of this definition, Audretsch and Caiazza (2016) then argue that entrepreneurship is therefore an endogenous response on the new knowledge opportunities created by organisations' investments that are unable to commercialise the opportunities exhaustively.

Several studies have argued that this investment in knowledge creation increases entrepreneurial opportunities, bringing about an entrepreneurship rate increase and in so doing, positively affecting economic growth in the country (Audretsch & Caiazza, 2016).

In North America, Japan and Europe, research has shown that an increase in entrepreneurial activities has resulted in a sustainable economic growth environment (Ciazza, 2014b; Callejon, & Segarra, 1999). Hyderabad and Gurgaon in India have achieved their highest growth of per-capita income through the promotion of high-tech entrepreneurship (Audretsch, 2007; Audretsch & Caiazza, 2016). In Africa, the field of entrepreneurship is still "under-researched and research tailored to the different development levels, of countries is important" (Urban & Kujinga, 2017; Urban, 2010).

The Global Entrepreneurship Monitor (GEM) report which is an indicator that is used to monitor global entrepreneurial activities, reported South Africa's early–stage entrepreneurship to be on the decline since 2014 with a notable decrease from 31 to 51 of total earl –stage entrepreneurial activity index (Herrington & Kew, 2016). This is concerning as the rest of Sub-Saharan is experiencing growth in entrepreneurship.

With the majority of South African population being youth (18-24), the results are concerning and some researchers have pointed out that the poorly aligned educational system is also part of the reasons of low entrepreneurial activity level. Co and Mitchell (2006) argue that educational systems do not prepare students to be entrepreneurs, but rather employees.

2.3.1 *Academic Entrepreneurship*

There are several definitions of academic entrepreneurship, with scholars focusing on the creation of new firms (spinouts) defined as a new company that is created from exploiting the intellectual property emanating from the research institution, per Shane (2004), cited by Wood (2011). Some scholars include patenting and licensing as part of their definition of academic entrepreneurship. Etzkowitz' (2003) definition suggests

inclusion of “organisational mechanisms” that will facilitate commercialisation across the institution and incorporation of both academic and non-academic aspects in the institutional framework which are broader than patents, licences and spinout.

A different perspective that is inclusive is postulated by Jain, George, and Maltarich, (2009), which views academic entrepreneurship as “any form of technology transfer activity” that could result in commercial benefit. It is widely acknowledged by scholars that not only licensing, and spinouts constitute academic entrepreneurship activities, but include a wide variety of entrepreneurial activities ranging from contract research and collaboration which could lead to academic and commercial rewards (Jain, George, & Maltarich, 2009).

From the perception of the entrepreneurial university, Wood, (2011) asserts that the notion of entrepreneurship revolves around the creation of new ventures, as well as growth of existing ones and that through research conducted, universities are the foundation of ideas and technologies that have a potential to drive entrepreneurship. The entrepreneurial universities’ notion, over time, merged with the academic entrepreneurship concept that is used as an “umbrella term” that denotes activities and efforts that universities engage in with industry to commercialise the research outputs (O'Shea, Allen, Chevalier, & Roche, 2005). This notion is premised on that research output from universities has the potential to be commercialised and to generate revenue for the institutions (Wood, 2011).

A different perspective focusing on the institution and the researcher views academic entrepreneurship as a phenomenon whereby a researcher develops “daily activities” within an institution that has the environment and resources that are conducive to generating, transforming and exploiting knowledge (Urbano & Guerrero, 2013).

In the 19th century, universities experienced the first academic revolution as they had to add from the normal academic duties research (Etzkowitz, 2003). With universities now doing more than research, came another mission of transforming universities so that they teach, research and engage in economic development. This revolution started with Massachusetts Institute of Technology (MIT), and was later adopted by Stanford and

now it is a wide-spread phenomenon as universities have the need to create knowledge resources to stimulate economic growth (Etzkowitz, 2003).

Universities have taken up the challenge not only to transfer knowledge, but to also transition from dependence on government to be self-sustaining (National Science Foundation, 1999). This transition is argued by many researchers to be painful and difficult to achieve as universities have to develop commercial capabilities (Ambos, Makela, Birkinshaw, & D'Este, 2008).

Because of an increasing need to address economic challenges, the Higher Education Institutions have pressure to contribute not only locally, but also to be internationally competitive (Wood, 2011). In South Africa, HEIs are expected to contribute to local economic and social development and are expected to be at the centre of regional development strategies (Gibb & Hannon, 2005). Supporting this assertion, Wood (2011) views academic entrepreneurship as a series of push and pull activities that university and industry engage in to commercialise and not as a "single event". The university has to look for suitable industry partners that possess appropriate skills to further develop and commercialise the idea, at the same time protecting their ideas.

For the purposes of intellectual property, there has to be an agreement between the institution and industry to license the intellectual property to an existing company or a start-up company created to exploit the intellectual property (Wood, 2011). He further describes this process as a promotion of collaboration between university and industry that will have spill overs. He further notes that there is plenty of literature that focuses on opportunity identification and exploitation, but little research has been done to understand factors that promote the development of entrepreneurial skills among academics.

The challenges of the entrepreneurial university include, among other things, that the university has to transform from traditional activities that it was accustomed to and build capacity that will enable the new mission of commercialising technologies (Ambos, Makela, Birkinshaw, & D'Este, 2008).

Consequently, pressures rise at the institutional level as it endeavours to manage traditional and commercialisation activities simultaneously. The tension is also experienced at the individual level whereby the researcher has to balance his or her time with the competing demands (Rasmussen & Wright, 2015). The ambidexterity in the organisational theory is debated to be hard to manage (Ambos, Makela, Birkinshaw, & D'Este, 2008). Etzkowitz (2003) argues that research shows challenges in the university structures and policy, in contrast to what is anticipated from these universities to manage the conflicts arising from these demands.

The enactment of Academic Entrepreneurship in the United States started with the Bayh–Dole Act that brought the aspect of entrepreneurial and economic development activities in universities (Guerrero & Urbano, 2012). Looking at the United States' response to this growing need for universities to play a crucial role in the knowledge centred economy as a result in the decline of industrial research laboratories, Jacob, Lundqvist, and Hellsmark (2003) posit that the response has been slow and limited in terms of innovation ecologies at and around universities, partially because of no change in incentives for academics. He has called for expansion of incentive criteria to include commercialisation activities.

In response to this phenomenon, the Organisation for Economic Co-operation and Development (OECD) countries renewed their legislation to create a productive, entrepreneurial and creative link to form a link between education and research in universities and for universities to be alert to entrepreneurial opportunities (Kirby, Urbano, & Guerrero, 2011). They proposed a framework that has informal and formal factors that contribute to the entrepreneurial university.

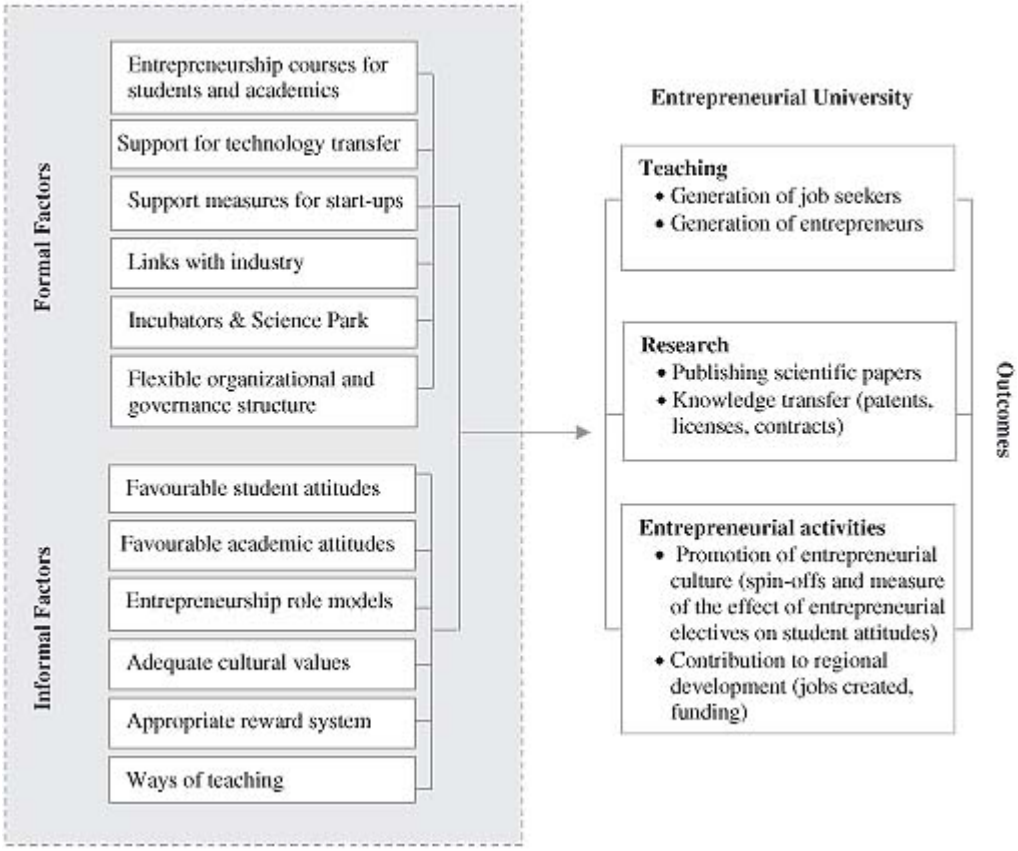

Figure 2: Making Universities More Entrepreneurial: Development of a Model (Kirby, Urbano, & Guerrero, 2011)

Universities have developed activities that promote entrepreneurship as a response to the economic development and social responsibility need. The World Economic Forum's Global Competitiveness Report in 2011 highlighted the crucial role HEIs have to play in countries' global competitiveness through their human capacity and efficiency and that there has to be sufficient investment in Research and Development (R&D). There is a need to produce high quality research and for there to be effective collaborations between research institutions, government and industry to facilitate the diffusion of these outputs (Allessandrini, Klose, & Pepper, 2013).

Research institutions have a vital role to play as catalysts to design policies, create a conducive environment and activities that, through the exploitation of research outputs, will motivate academic entrepreneurs to not only make technological success of their

ideas, but to also reward new ventures that have an impact on the regional economy and social development (Urbano & Guerrero, 2013).

Following this suggestion, research has shown that universities developed customised instruments and mechanisms to create an environment that supports commercialisation by creating incubation centres within universities, technology transfer offices, and research facilities that can potentially reduce the conflict of interest between traditional and entrepreneurship efforts (Urbano & Guerrero, 2013).

Literature has shown that embracing the academic entrepreneurship in universities has several challenges, such as human capital with academic expertise rather than business acumen, balancing the academic and entrepreneurial activities and that the researchers have strong links in the academic arena and less with the commercial world (Guerrero & Urbano, 2012).

2.3.2 *Academic Entrepreneurship in South Africa*

South Africa, like other countries, in response to the growing need to exploit the research outputs, formalised the technology transfer process by establishing a dedicated technology transfer office (Allessandrini, Klose, & Pepper, 2013). The role of the technology transfer office is to identify, protect and commercialise the research output from these institutions (Allessandrini, Klose, & Pepper, 2013).

South Africa's definition of technology transfer is broad in that it does not only focus on commercialising IP for financial gain, but also for social benefit, even though the measurements of a successful technology transfer focuses on commercialisation and revenue generated by the universities (Allessandrini, Klose, & Pepper, 2013).

For a technology transfer to be successful, it is imperative for institutions to recognise the inventors' role in the technology transfer process as they are the key resource through their expertise and know-how of the technology or product. Technology transfer personnel play a role as they identify, provide guidance of the best way to protect and commercialise the Intellectual Property and also in establishing and

maintaining the relationship with industry to market and licence the technologies (Sandelin, 2003). At an institutional level, policy and structural changes accompanied by the top management support are key to the success of the technology transfer (Allessandrini, Klose, & Pepper, 2013).

Globally, the concept of academic entrepreneurship is not a new phenomenon amongst researchers and academic staff in higher education. Funding is channelled to research solving socio-economic challenges and so institutions need to adjust their behavioural pattern to address the social needs. This adjustment of behavioural patterns has led to the "knowledge society" narration changing from just production research output to institutions seen as "enterprises" and academics as "entrepreneurs" in response to the social and economic needs (Grundling & Steynberg, 2008).

The knowledge economy is nowadays viewed as based on the application of the intellectual property and the value it adds in the economy which implies that higher education institutions in South Africa have a vital role to play in adding value not only domestically, but also globally. Grundling and Steynberg (2008) observed that the current status of academic entrepreneurship in South Africa is relatively weak; they further argue that it is also modest because of the historical past of the South African education system.

They further propose that the success of technology transfer in South Africa will occur if it follows the international trend of creating a linkage between universities and industry/ market through science parks technology centres (Grundling & Steynberg, 2008).

The Global Innovation Index 2017 ranks South Africa on innovation inputs at 57, dropping from 49 in the year 2016 with outputs dropping from 49 to 69 (Global Innovation Index, 2017). GII ranks economies looking at their innovation capabilities and their results. The indicators used, amongst other things, include human capital development and research, performance by universities, patent applications.

The GII definition of innovation is from the Organisation for Economic Co-operation and Development (OECD): "innovation is the implementation of a new or significantly improved product (good or service), a new process, a new marketing method, or a new

organizational method in business practices, workplace organization, or external relations" (Cornell University, INSEAD, & WIPO, 2017).

Looking at the innovation efficiency from the GII, 2017 report; this is calculated as a ratio of the output index over the input. South Africa ranks at 94 out of 126 countries. Innovation efficiency is used to assess the effectiveness of the innovation systems and policies of the country that drive or impede innovation. Another important and interesting measure is innovation achievers. This measurement assesses a country's GDP growth compared to similar countries. In the Sub-Saharan Africa region, South Africa is rated as performing at "level of development" with Kenya as an over-achiever five times in the past six years (Cornell University, INSEAD, & WIPO, 2017).

With the growing need for South Africa to realise the value added of the scientific output for economic and social need, the question raised is how do institutions then incentivise academics to work with industry as this will facilitate better transfer of the technologies? Looking at the top management support, rewards and incentives and time allocation, this study aims to look at the current practice and environment in the research institutions to determine if they have transformed to accommodate the growing need to create an environment to generate knowledge that has value in the economy.

A study by Cuervo (2005), mentioned by Veciana and Urbano (2008), characterised environmental factors into micro and macro indicators of the economy and institutional environments which are regulations, public policies, the education system and culture. There have been many studies on environmental incentives that promote entrepreneurship but Semerci and Cimen (2017) argue that the approach has been mostly on the economic point of view and under environmental incentives, focus has been only on two variables, entrepreneurial culture and administrative policies as fundamental factors in shaping the environment.

An addition to these is the role universities have in fostering entrepreneurship through their strategies which Mok (2005) stresses, can be achieved through government regulations that provide an enabling environment for them to play their role.

In a study conducted by Rorwana and Tengeh (2015) which looked at academic entrepreneurial culture in faculties of a university of technology in South Africa, it was reported that 50% of the staff members had a semi- or moderate entrepreneurial culture, 39% viewed their faculties as having a weak academic entrepreneurial culture while 11% believed they had a high academic entrepreneurial culture.

An interesting finding from this study was that the majority of faculty members did not believe that availability of funding was a factor in the creation of innovative products. This poses a question regarding what the impediments and enablers of innovative thinking in the institutions are because the same study showed that 61% of the researchers were passionate about producing innovative products and a majority attributed their low production of innovative products to the faculty commercialisation culture (Rorwana & Tengeh, 2015).

2.3.3 *Technology Transfer Offices in South Africa*

The role of government is to create an enabling environment for industrial innovation, entrepreneurship and to provide legislation that governs intellectual property (Rasmussen, Moen& Gulbrandsen, 2006). Government has had many attempts to encourage technology transfer in South Africa from as early as the 1980's (Wolson, 2007). In 1996, a White paper was passed with the aim of encouraging innovation that would result in growth, competitiveness and improvement of a quality livelihood of the people of South Africa. In the White paper, the concept of National Innovation Systems was established and other strategies and policies that would contribute to the development of science and technology in South Africa were outlined in the paper (Nyatlo, 2015).

In 2003, an Intellectual Property Rights policy framework for South Africa was presented with the objective of moving South Africa from being a resource-based to a knowledge-based economy (Kloppers, Tapson, Brandshaw & Gaunt, 2006).

Internationally, the establishment of the technology transfer trend dates back to the 1970's, as a result of the need to account and efficiently use research resources (Nyatlo, 2015). The interaction of university and industry to facilitate the commercialisation dates back 25 years (Bercovitz & Feldman, 2008) and has been recognised as an important factor in bridging the "innovation chasm" as a result of insufficient resources and industry knowledge (Nyatlo, 2015).

There have been many terms to classify the technology transfer process. Some have referred to this process as "academic capitalism" because it is geared to make a profit (Slaughter & Leslie, 1997). A different view (Branscomb, Kodana , & Richard, 1999) is that of "entrepreneurial university". This encourages links between researchers and industry to better integrate and commercialise the research output, cited by Nyatlo (2015). Confirming this, Nyatlo (2015) citing the Organisation for Economic Co-operation and Development (2003) suggests that a strong entrepreneurial orientation of academic researchers is vital for successful technology transfer.

Gabrielsson et al. (2012) assert that the importance of university research is widely acknowledged as universities not only provide human capital development but promote growth of regional and perpetual economies (Rasmussen, et al., 2006).

Following the USA Bayh-Dole Act in 1980, South Africa promulgated the IPR Act in 2010 with the objective of creating "intellectual property emanating from publicly financed research and development is identified, protected, utilised and commercialised for the benefit of the people of the Republic, whether it be for social, economic, military or other benefit" (RSA, Intellectual Property Rights from Publicly Financed Research and Development Act, Number 51, 2008).

As part of this, these universities are expected as per the objects of the IPR Act, to report on benefits of their work to the society to ascertain that the R&D is disseminated for the betterment of South African citizens. The National Intellectual Property Management Office (NIPMO) was established as an office that will oversee the implementation of the legislation and also to establish and develop the technology transfer office across in the institutions.

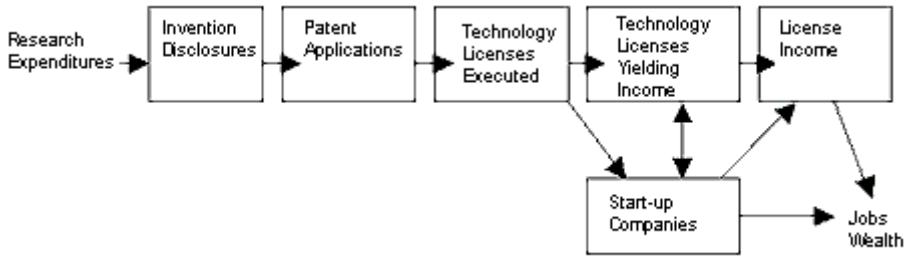

Figure 3: Technology transfer process (Friedman & Silberman, 2003)

Amongst other reasons for the low rate of start-ups is the perception of risk, lack of entrepreneurial culture despite the existence of IP policies in some institutions, and the absence of a technology transfer office (Sibanda, 2009).

Researchers have argued that universities in Africa lack an enabling environment that will position them in an entrepreneurial role. Ssebuwufu, Ludwick, and Beland (2012) have a different view in that they believe that industry linkages, policies and practices that are aimed at linking industry and university research have improved,

The focus on academic entrepreneurship has been noted to have been the response to external forces in the economy that have brought political changes in the higher education arena that resulted in disinvestment in tertiary education, propelling universities to look for new streams of income that will assist in balancing their budget to circumvent their looming financial crisis (Shore & McLauchlan, 2012).

Even though the government plays a significant role in creating a conducive environment in the macro level, universities also have a role to play internally by creating policies and processes that enable exploitation of the intellectual property. It has been argued that the rate of university start-ups is determined by the quality of the technology transfer office. This would also mean the institution as a whole has technology transfer and it does not function independently (Wolson, 2007).

Resources invested in the technology transfer office determine the success of academic entrepreneurship. Universities that have invested considerably on licencing activities have experienced success in spin offs and for those that have not invested in technology transfer, the reverse is true ((Wolson, 2007; Wright, Birley, & Mosey, 2004).

2.3.4 *Organisational culture and climate*

This study approaches organisation as an institution (Zucker, 1987) borrowing from the perception that organisations as institutions have changed as a result of internal elements, or form trends, but not as a result of power or processes from the government (Huyghe & Knockaert, 2014).

The study uses both climate and culture theory based on the theoretical reasoning that these concepts are closely related (Buschgens, Bausch, & Balkin, 2013). Researchers agree that climate is the surface where culture manifests per Schein (2000) cited in Buschgens, Bausch, and Balkin (2013). Pritchard and Karasick's (1973) definition of climate is that climate is the employees' perceptions of the environment within the organisation and its manifestation serves as a representation of culture as it is based on underlying values and assumptions ((Buschgens, Bausch, & Balkin, 2013).

Furthermore, Scott (2001) terms institutions as "multifaceted" long-lasting social structures "made of symbolic elements, social activities and material resources", managed by centralised regulations, values and norms, cited in Huyghe and Knockaert (2014). He further states that these rules are what shapes and influences the behaviour of individuals in the organisation by either motivating or impeding certain activities.

Barnery (1986) defines organisational culture as "multifaceted values, beliefs, assumptions and symbols that define the way in which a firm conducts business" whereas Hofstede's (1998) definition views culture as "collective programming of the mind". Shibanyama (2015) argues that organisations should have a flexible orientation that allows diverting from existing processes and procedures used in implementing innovation. This approach assists institutions to adapt to a changing external environment.

Nelles and Vorley (2010), looking at the entrepreneurial architecture for the third mission, observed that institutions need a collection of internal factors that will assist in creating entrepreneurial agendas; these include institutional, communicative, co-ordination and cultural elements. Furthermore, they argued that for the institution to see development and success in the integration of the third mission, institutional

strategy should have inner connected links and goals with the third mission streams and activities.

Jacob, et al. (2003) cited by Nelles and Vorley (2010), looking at the Chalmers University of Technology, notes that the success that hinders "entrepreneurial turn" amongst others, is the lack of awareness and interest in the "third mission", unclear commercialisation infrastructure and absence of the culture of entrepreneurship in the university.

With this understanding of institutional perspective, this study therefore looks at the organisational preparedness for academic entrepreneurship after the IPR Act came into effect. Nelles and Vorley (2011) assert that culture reflects the attitudes of organisations' personnel whether they place importance on innovation and their inclination to entrepreneurial engagement.

Shibanyama (2015) concurs with the need for social contribution to science but raises a concern on the "commercialisation regime", pointing out that it can create a self-regarding climate which compromises the premise of academic science (Dasgupta & David, 1994; Nelson, 2014). The rationale is that science is formed on the basis of open science and results are regarded as the property of the science community that could normally be unconditionally shared through publications and other forms with the community (Dasgupta & David, 1994).

Empirical studies have shown that academics who engage in commercial activities deviate from this norm of co-operation and are not willing to share their knowledge and resources for their personal benefit (Campbell, et al. 2000; Walsh, et al. 2007).
According to Sibanda (2017), the effectiveness of the IPR Act on its attempt to bridge the "innovation chasm" also relies on the culture, skills and funding that will assist in the translating of research output into products and services.

A study conducted by Bercovitz and Feldman (2006) tracking 1780 members who engaged in academic entrepreneurship, to examine their background and work environment, showed that personal attributes were conditioned by the local working

environment. This means that individuals are likely to engage in academic entrepreneurship if they are groomed at institutions that are actively engaged in technology transfer. Interestingly, the results showed that the individuals that graduated recently were more willing to embrace commercialisation norms than those who had graduated a while ago. Furthermore, if the chair of the department is active in commercialisation, the department members are also likely to participate.

An interesting assertion in research is that, in some instances, even if the top management recognises the need to change, communicates that with new strategic initiatives, modifies incentives and allocates resources to create a conducive environment for commercialisation, existing routines and norms more frequently than not, impede the organisational transformation. This is more common in institutions that have a strong tradition and have deep rooted norms of behaviour whereas some adapt, change and flourish (Bercovitz & Feldman, 2006).

Bercovitz and Feldman (2006) postulate that external pressures at the macro level do not assure that new commercialisation initiatives will be embraced; the organisational change solely depends on the individuals to embrace new norms, routines and behaviours.

It is important for the institution to get the buy-in of the new strategy from the inventors because the success of the entrepreneurial activity which is measured by various indicators is only possible through invention / idea disclosure done by the researcher which is the first step to commercialisation (Bercovitz & Feldman, 2006).

2.3.5 *Top Management support and University mission*

The Entrepreneurial university plays a pertinent role as a knowledge producer and diffusion institution (Guerrero & Urbano, 2012). Etzkowitz (2003) points out that the mission of these universities is threefold - teaching, research, and entrepreneurial activities, concurrently. For a university to be regarded as an entrepreneurial university,

members need to become entrepreneurs and the environment needs to be conducive (Guerrero & Urbano, 2012, citing Ropke, (1998).

Adopting the entrepreneurial culture may be challenging for universities as their primary focus is towards teaching and research and this will require the university to change their culture and include entrepreneurship in their mission statement (Ambos, Makela, Birkinshaw, & D'Este, 2008; Huyghe & Knockaert, 2014). The adoption of an entrepreneurial culture is further supported by an argument by Schein (1985) that organisational culture gives understanding and context to members, thereby influencing their thinking consciously and sub-consciously (Huyghe & Knockaert, 2014). An Entrepreneurial culture will channel how members think, how they set goals and fulfil their roles (Huyghe & Knockaert, 2014).

To achieve an entrepreneurial culture, a university needs entrepreneurial organisational structures that will form a connection between teaching, research and administrative functions that support this vision (Guerrero & Urbano, 2012).

University efforts must be directed to providing an enabling environment for entrepreneurship, economic growth and regional entrepreneurship (Guerrero & Urbano, 2012). This can be done by providing business incubators and technology transfer offices that will support university spin-offs and have programmes that will improve skills, attributes and behaviour to be creative and critical thinkers (Guerrero & Urbano, 2012). Kirby (2005) argued that entrepreneurship can be promoted through a reward system.

Referring to the University of Surrey in the United Kingdom, Kirby (2005) noted that universities must embrace the principles of entrepreneurship development. Furthermore, he added that it is not enough for universities to incentivise or put infrastructure in place; rather, a culture of enterprise is needed to encourage and enable researchers and students to commercialise intellectual property and invention. According to Detert, Schroeder, and Mauriel (2000), one common denominator that leads to failure of quality efforts was not changing the culture or the environment.

Hall and Soskice (2001) cited in Etzkowitz, et al. (2008) claims that the common objective of an Intellectual Property regime is to inspire the universities to be more entrepreneurial, regardless of cultural, economic and political traditions. Zucker and Darcy (2001) argued that important drivers of this third mission are also found within departmental leadership through providing examples and lobbying governing boards that are determined to encourage academic entrepreneurship (Nelles & Vorley, 2010).

For universities to identify and exploit the entrepreneurial opportunities, institutions need to create a conducive climate that will promote innovation and entrepreneurship. Muller (2007) suggests reducing the levels of bureaucracy that make institutions rigid to create a supportive environment for commercialisation. Various authors have concurred that a university mission that incorporates entrepreneurial orientation has a potential of changing the attitude of the academics (Kirby, 2005;O'Shea, Allen, Chevalier, & Roche, 2005;Guerrero & Urbano, 2012; Rothaermel, Agung, & Jiang , 2007).

Examples of this include Duke, Johns Hopkins and Pennsylvania State universities that had linkages through strategical linking information capabilities and incentives alignment, and their performance improved (Bercovitz, Feldman, Feller, & Burton, 2001). Supporting the suggestion that a university mission includes entrepreneurial orientation (EO), Audretsch and Lehmann (2005) assert that if the mission includes EO, policies and practices, it will facilitate academic entrepreneurship. Guerrero and Urbano (2012) and O'Shea, Allen, Chevalier, and Roche (2005) believe that the governance structure needs to be realigned as it outlines the entrepreneurial university mission in which technology transfer is viewed as an automated and spill over effect of research activity.

O'Shea, Allen, Chevalier, and Roche (2005) examine further than the mission and strategies of an institution and they look into the physical resources. They assert that in generating knowledge for economic development, institutions should also invest resources on developing research centres that will attract entrepreneurs and capital

that will provide a set of skills and finance to start new ventures (Guerrero & Urbano, 2012). The dynamics of a region's formal and informal institutions have an effect on how knowledge is created, transferred and commercialised by different participants in the ecosystem (Acs & Stough, 2008).

a. ***Hypothesis 1***

H1 Top management support for academic entrepreneurship has a positive relationship with academic entrepreneurship

2.3.6 *Rewards System and Time allocation*

McInnis (2001) argued that the efforts to transform the university to an entrepreneurial culture will be challenging, if not fruitless, if the leaders do not take cognisance of the skills, passions and outlook of academics. This suggests that an institution must not force academics into projects or areas that are out of their scope or interest but rather endorse their strengths. This should be a win-win situation for the institution and the academics. If forced, academics might lose interest. Allowing them to focus on what they do best is more likely to promote creative entrepreneurialism which is referred to by Clark (1998) as collective entrepreneurial action.

Collective entrepreneurial action is suggested to aid the failure of university culture as the researchers may be deeply embedded in their daily habits of work and have resistance to change. With the change that comes with the adoption of entrepreneurial culture and a need for outputs, there is supporting evidence that shows that academics are willing to adopt change in institutions that create a culture of opportunities. This will not be possible without balancing with the motivating factors, that is intrinsic and extrinsic factors (McInnis, 2001).

The motivations which are important to foster entrepreneurial creativity are intrinsic and extrinsic. Research has shown that extrinsic motivators support creativity. According to McInnis (2001), one of the intrinsic motivations is reward and recognition for creative ideas. Autonomy in the work and a sense of interest and excitement at work encourages entrepreneurial creativity (McInnis, 2001).

Amabile (1997) describes extrinsic motivators as tangible rewards that will keep the entrepreneur interested, like receiving funding as a reward or sharing in the profit margins (McInnis, 2001). Getting rewarded also gives assurance to researchers for their competence without controlling them. This is important when developing the entrepreneurial culture in academic environments to avoid resistance to change which might result in researchers losing interest.

Amabile (1997) argues that if entrepreneurs feel that their self-determination is undermined, they might disengage from issues to be solved and their creativity will decline. In concluding his argument, McInnis (2001) highlighted the principles to be followed by institutions to create the entrepreneurial culture; he points out that academics must be recognised and the agenda for entrepreneurship should be part of their priorities. This must be done with an understanding that academics need not all be entrepreneurs. He further recommends that entrepreneurial goals of an institution should be noticeable from recruitment, induction programmes, and in the criteria for advancement and promotion.

Huyghe and Knockaert (2014) maintain that if institutions incorporate a reward unequivocally for entrepreneurship activities rather than research and teaching, more researchers will participate in these activities.

Technology transfer activities and rewards system for universities are misaligned. Beyond the small amount the researchers receive from the royalties, there is no other benefit for commercialisation (Yodalahi, Meisam, Mahmoud, & Aidin, 2014). Seigel, Waldman, Atwater, and Link's (2003) findings, based on the interviews conducted in five different universities, showed that reward systems are not aligned to technology transfer aspirations and that these activities must actually have a greater weight in career progression (Sanberg, et al., 2014).

The academic entrepreneurship approach has been bottom-up; researchers are expected to deliver on the third mission without the university playing a role including academic entrepreneurship activities in career advancement (Yodalahi, Meisam, Mahmoud, & Aidin, 2014).

Nelles and Vorley (2011) argue that incentives for faculty members and units that engage in generating third stream funds should be part of the entrepreneurial strategy of the institution.

Current policies in these institutions, at best, mostly tolerate the commercialisation efforts; only a limited number of organisations have considered building their careers on commercialisation lines, regardless the misaligned rewards systems (Sanberg, et al., 2014).

Introducing a rewards system is argued to be one of the effective strategic actions to motivate for academic entrepreneurship. The rewards can be monetary through bonuses, profit sharing or non-monetary in the form of promotion and recognition, (Kirby, 2005;Bernasconi, 2005). These incentives are a motivation for the time, skill, and administration time invested to engage in commercialisation that could be helpful in motivating for academic entrepreneurship as a career prospect for researchers (O'Shea, Allen, Chevalier, & Roche, 2005).

Another assertion by Lach and Schankerman (2008) is that there is misalignment in the incentives with regards to technology transfer activities and researchers with respect to career progression and merit raises except the monetary benefit from the royalties which are relatively small. Lach and Schankerman (2008) argue that most policies still emphasise focusing on publications, not on use-orientated research and development and research.

Renault (2006) asserts that as long as there exists misalignment between intellectual property and promotion policies to guide the faculty on what is appropriate and a desired outcome on commercialisation, institutions will experience reluctance in participation on these activities from researchers. Furthermore, Renault (2006) emphasises that until licencing and spin-offs are seen as part of the scholarly contribution by institutions, the amount spent on these activities by researchers will significantly reduce over time.

In interviews and surveys conducted by Lach and Schankerman (2008) it came out that rewards systems and institutional aspirations for technology transfer are not aligned,

with respondents specifically highlighting that technology transfer activities should have a significant contribution to career advancement.

The American Academy of Arts and Sciences report advocates for universities to change the current weighting system on rewards, to give more weighting on "public service" and consider inclusion of knowledge transfer and entrepreneurship as a public service. A survey conducted by the National Council of Entrepreneurial Technology Transfer (NCET2) in 2012 showed that only 25 of the top 200 national universities in the United States and Canada include patents and commercialisation in tenure decisions.

The NCET2 report noted that even the staunchest supporters of the inclusion of faculty patenting and commercialising activities into tenure and career advancement decisions agree that these activities should not replace scholarly pursuits, such as teaching and mentoring students and publishing research.

a. ***Hypothesis 2 and 3***

H2 There is a positive relationship between a university reward system and academic entrepreneurship

H3 Time allocated for researchers to work on their innovative idea is positively related to academic entrepreneurship

2.4 Conclusion of Literature Review

The importance of top management support, rewards and incentives and time allocation for researchers to focus on academic entrepreneurship was discussed in this chapter. For academic entrepreneurship to be realised, there has to be culture and a climate that promotes the translation of research output. From the literature, the following hypotheses were proposed:

2.4.1 *Hypothesis 1: Top management support for innovation activities has a positive relationship with academic entrepreneurship*

2.4.2 *Hypothesis 2: There is a positive relationship between a university reward system and academic entrepreneurship*

2.4.3 *Hypothesis 3: Time allocated for researchers to work on their innovative idea is positively related to academic entrepreneurship*

The conceptual framework (Figure 4) illustrates the relationship between academic entrepreneurship and corporate entrepreneurship. This framework is based on the literature on academic entrepreneurship and corporate entrepreneurship, focusing on the organisational preparedness for academic entrepreneurship.

Conceptual Framework for organisational preparedness for academic entrepreneurship

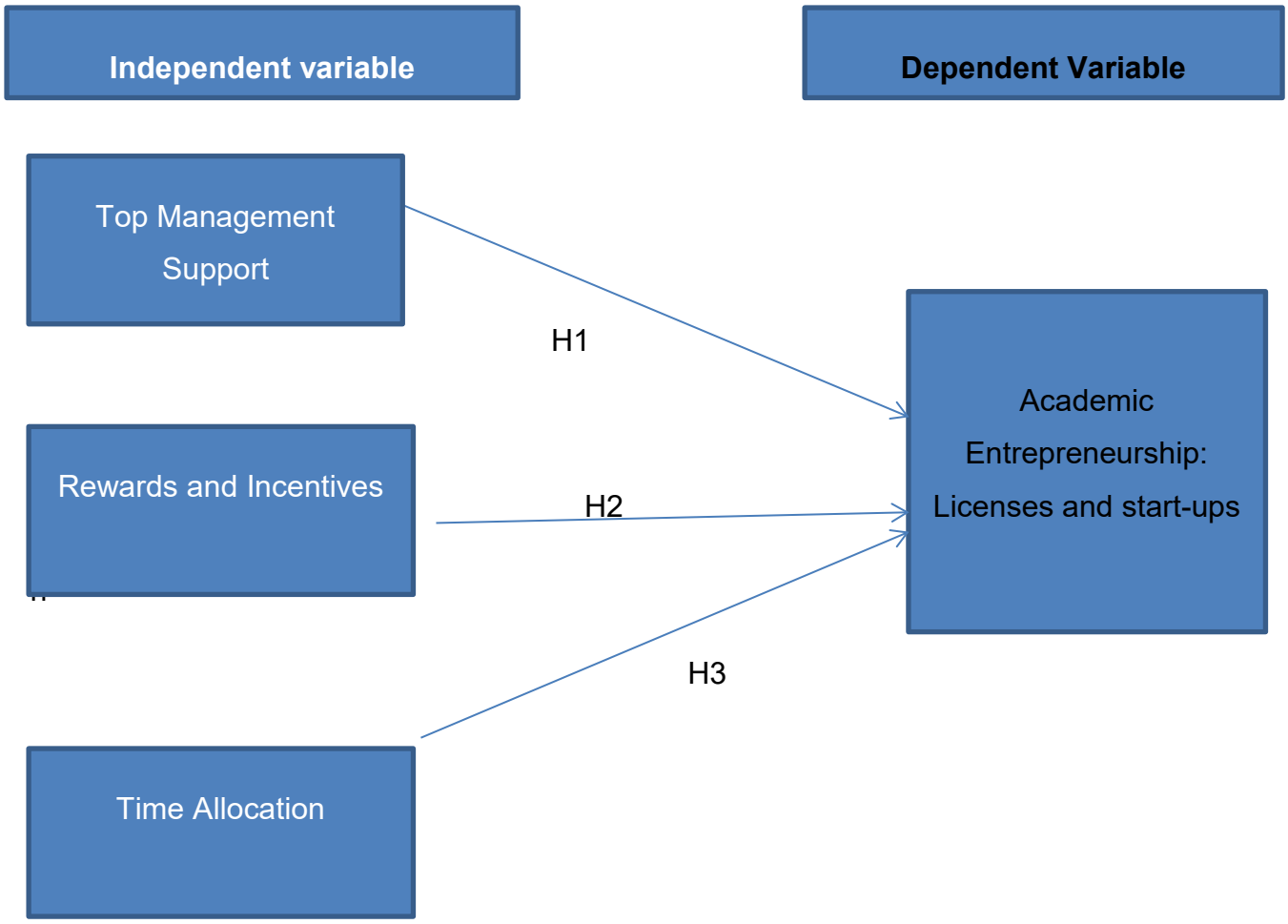

Figure 4: Conceptual Framework for organisational preparedness for academic entrepreneurship

CHAPTER 3. RESEARCH METHODOLOGY

This research study is based on quantitative and cross-sectional design. The research methodology chapter describes in detail the approach and design, population and sample, data collection and analysis. This chapter also presents the validity and reliability of the research design and limitations of the study.

3.1 Research methodology /paradigm

This study follows the positivistic paradigm which represents objectivity, measurability and controllability, among other things. This paradigm employs a deductive approach using theory to explain observations, a quantitative research approach to test the relationship between theory and the hypothesis of this study (Kruger & Struwig, 2012). Within the positivistic approach, the study follows an epistemology of investigating the constructs through objective methods remaining at arm's length when collecting data from correspondents.

There have been similar studies that were conducted on organisational climate and culture (Huyghe & Knockaert, 2014; Brennan & McGowan, 2006) using corporate entrepreneur concepts to assess academic entrepreneurship; there is also literature on organisational preparedness for corporate entrepreneurship by Kuratko, Hornsby, and Covin (2014).

This study was an empirical research defined (Cooper & Schindler, 2014) as a scientific study that tests the theory and hypotheses. This study follows the empirical research approach, a relationship between academic entrepreneurship, top management support, time allocation and rewards for academic entrepreneurship was deduced from literature and hypothesised to have a positive relationship.

3.2 Research design and instrument

A quantitative and cross-sectional design was employed in this study whereby the data was collected using a survey and emailed questionnaires. A survey method was

preferred as a means of collecting data because it requires less time and allows participants to remain anonymous (Cooper & Schindler, 2008).

A quantitative research design has been used in the corporate entrepreneurship study by Kuratko, Hornsby, and Covin (2014). Huyghe and Knockaert (2014) also used it in the organisational culture and climate survey of academic entrepreneurship.

Data was collected using a questionnaire as an instrument and a correlational design was adopted in the study to test multiple variables for respondents, to find the relationship and strength of the relationships between strategic renewal and academic entrepreneurship (Gravetter & Forzano, 2012). Because of low responses to the survey, data was collected using hard copies of the survey. The data collected was then captured on Excel and was measured numerically to provide ordinal data.

The study employed a self-administered online questionnaire as a research instrument. A survey is widely used instrument in collecting information because it is convenient, quick and it also allows the participants to think about the questions. The survey was distributed via email as it is easy to access and a reminder was sent to the participants. It was assumed that the participants in this study have access to computers so that they can provide quick responses. The questionnaire used a seven point Likert-scale to allow statistical tests to run to ensure reliability and validity testing.

The study used a quantitative research method, where ordinal data was collected using a measuring instrument, an online questionnaire that consists of close-ended questions. Qualtrics software was used to design the online questionnaire. A manual survey was drafted and hand delivered to the researchers because of low responses to the online survey.

The ordinal data collected was measured using close-ended questions on a seven point Likert measurement scale. The questionnaire was structured in a seamless selection for ease of use by respondents (Cooper & Schindler, 2008). The survey was sent with a cover letter that stipulated the instructions and ethical aspects of the research. Ethics are important to ensure the safety and anonymity of the respondents (Cooper & Schindler, 2008).

The instrument consisted of questions about the demographics of the participants and the subsequent questions measured the independent and dependent variables which were formulated from the literature. The actual instrument that was used is attached In Appendix 1.

3.3 Population and sample

3.3.1 *Population*

The population of a study is defined as a complete group of people, organisations, students or anyone who share some set of characteristics (Zikmund & Babin, 2006). The population of this study comprises post-graduate students, post-doctoral fellows and academic researchers at universities and research organisations in South Africa.

3.3.2 *Sample and sampling method*

Sampling is the selection of the elements in a population that can be used to draw a conclusion (Zikmund & Babin, 2006). For this study, a non-probability convenience method was utilised, with a sample drawn from science councils and universities. The first criterion of choosing the institutions was based on the institutions with intellectual property that is governed by the IPR Act (RSA, Intellectual Property Rights from Publicly Financed Research and Development Act, Number 51, 2008).

Secondly, the university and science council selected below are based in the Gauteng Province. The reason for choosing Gauteng was because of time and resource limitations in undertaking the research study.

Although the study envisaged sampling nine institutions, only three institutions were surveyed because of delays in getting permission and assistance to distribute questionnaires. A survey via email with an online questionnaire from Qualtrics was sent

to three institutions, the Council of Scientific and Research (CSIR), University of Witwatersrand (WITS) and Vaal University of Technology (VUT)

CSIR is a research and development institution that was established through an Act of Parliament in 1945.The CSIR staff complement consists of two-thirds of scientists, engineers and technologists who share a passion for “shaping a better future through science and technology innovation (CSIR, 2018).

The University of Witwatersrand is internationally recognised for excellent research and high academic standards and is ranked number 9 out of 100 universities in Emerging and BRICS countries (WITS, 2018).

Vaal University of Technology (VUT) is a university of technology that was established in 1966, and offers industry-tailored academic programmes. VUT is currently the only university that fully owns a science and a technology park (VUT, 2018).

The response from the online survey was low and questionnaires were hand distributed to the three institutions that had already started completing the survey. In total, 2200 questionnaires were sent via email and hard copies. Out of that total, a total number of 264 responses were recorded.

Table 1: Profile of participants

Name	Number of Participants
Council of Scientific and Industrial Research	1200
Wits University	500
Vaal University of Technology	500

3.4 Procedure for data collection

The questionnaire was deduced from various instruments:

Table 2: Independent variable questions

Metrics	Variable	No of Questions	Article

1	Demographics	3	
2	Top Management	7	Assessing a measurement of organisational preparedness for Corporate Entrepreneurship; Hornsby, Kuratko, Holt and Wales
3	Rewards/Incentives	7	The influence of organisational culture and climate on entrepreneurial intentions among research scientists; Hughye and Knockaert
4	Time availability	5	Assessing a measurement of organisational preparedness for Corporate Entrepreneurship; Hornsby, Kuratko, Holt and Wales

Dependent variable

Data for the dependent variable was secondary data that was shared by Dr McLean Sibanda, which formed part of his thesis. The data consisted of the number of licences and start-ups created since 2006. From the data, the study extrapolated information for the three institutions. This consisted of the total number licences signed and start-ups created at CSIR, Vaal University of Technology and Wits University between 2008 and 2015.

Institution	**Number of licences signed**	**Number of Start-ups created**
CSIR	68	1
WITS	5	1
VUT	0	0

3.5 Data analysis and interpretation

From the data collected, the demographics were analysed on SPSS using descriptive statistical measurements. Normality of the data was tested using a Kolmogorov Smirnov Test. When analysing normal distribution, it is said that a variable should have a p –value of the Kolmogorov Smornov Test that is greater than 0.05, when the p-value is below 0.05, the variable is deemed to be not normally distributed.

3.5.1 *Data analysis and interpretation*

To analyse the predicted relationship between the specified variables, correlation, covariance, a multiple regression model was tested. For this research, the tests were done to determine the relationship between academic entrepreneurship and strategic renewal constructs. Correlation was analysed by using the Pearson correlation test to look into the continuous variables. Correlation looks at the assessment and also validates the level of the relationship that exists between the variables. The aim of doing a correlation is to have a positive relation which will be depicted by correlation that is +1.00 (Field, 2009).

Furthermore, a multi-regression was conducted to estimate the relationship between academic entrepreneurship and the three constructs. Multi-regression analysis allowed numerous independent variables of different strategies to be applied as a dependent variable and was also instrumental to quantify the relationship. The R square proportion has to vary between 0 and 1 and is symbolised by R^2 (R Square), (Field, 2009).

3.6 Limitations of the study

- This study focuses on one science council and two universities that are situated in the Gauteng province, therefore the results cannot be generalised to all the science councils and universities in South Africa**.**
- The limitation of the study is that the sample only includes science councils and universities in Gauteng and therefore the results cannot be generalised. The selection of the geographical area was influenced by the convenience and time constraints as data collection had to be completed within a month.
- The study was conducted and contextualised only to South African universities that are governed by the IPR ACT and therefore these results cannot be generalised to the rest of the world.
- Academic entrepreneurship has been typically researched in the Northern centric context and this study applies the theories in a different context.
- Academic entrepreneurship constructs in this study refers to licences signed and start-up companies created.

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3.7 Validity and reliability

Validity of an instrument is described as the extent to which a test measures what the researcher intends to measure. Reliability measures the accuracy of the procedure (Cooper & Schindler, 2008).

3.7.1 *External validity*

External validity focuses on whether the results of the research can be generalised across people, settings, or times that are not included in the study (Altermatt, 2013). Even though the sampled population represented a science council, a university and a university of technology, the study cannot be generalised to other institution in a similar category in South Africa.

3.7.2 *Internal validity*

Internal validity gives assurance that independent variables cause changes in the dependent variables and that there is no confounding variable that co-varies, causing changes to the dependent variables (Altermatt, 2013). The constructs were tested for validity using exploratory factor analysis and the instrument used was compiled from previous literature instruments. This is an important test for quantitative data as it ensures that the used experiment design follows the cause and effect principle.

3.7.3 *Reliability*

Reliability shows the internal consistency of the measurement. There has been different arguments on the definition of reliability by scholars but the generally accepted definition is that it looks at the probability of the research procedure producing the same result if it is repeated (Field, 2009). The assessment tool for this study has been tested for reliability and factor structure by many researchers including Kuratko, et al. (1990), Hornsby, et al. (1999), Huyghe and Knockaert (2014) and Hornsby, Kuratko, Holt, and Wales (2013)**.**

Using a Cronbach Alpha, the internal validity was examined to measure whether the dependent variable and independent variable are directly related (Field, 2009). Cronbach's alpha value of >0.9 indicates excellent reliability, >0.8 indicates good reliability, > 0.7 is an acceptable value for reliability, >0.6 is questionable, > 0.5 is poor while < 0.5 is unacceptable (Field, 2009).

The survey questions employed in the study were deduced from the following journal articles:

- *Assessing a measurement of organisational preparedness for Corporate Entrepreneurship*; (Hornsby, Kuratko, Holt, & Wales, 2013)**.**
- *The influence of organisational culture and climate on entrepreneurial intentions among research scientists*; (Huyghe & Knockaert, 2014).

3.8 Conclusion

The study followed a positivistic approach using ordinal data that was collected using an online survey instrument and a questionnaire. The online survey was gathered using Qualtrics Software and the research questionnaire was manually compiled on Microsoft Word. The survey was distributed to the institutions that were sampled. A total number of 264 responses were recorded.

From the responses, data analysis using descriptive statistics, testing normality of the variables, reliability, factor analysis and testing the relationship of the variables was conducted. The following chapter provides a detailed data analysis.

CHAPTER 4. PRESENTATION OF RESULTS

4.1 Introduction

Findings from the research are presented in this chapter. The data was collected, cleaned and analysed in SPSS, following the statistical analytical methods discussed in the previous chapter. The first part of this chapter presents the demographics of the sample of the study. The second part focuses on the descriptive statistics, followed by the correlation, and exploratory factor analysis and regression analysis that analyses different relationships that the study hypothesised in Chapter 2.

The data was cleaned to check that there were no missing values; an analysis of the demographics was done and is presented below.

4.1.1 *Descriptive profile of the study sample*

The data analysed below is from the responses from the survey that was distributed. Method of data collection was an online survey which was sent, but because of low response, physical copies were handed to participants for them to complete. The total number of surveys that were sent to three institutions were 2200. The total number of respondents from those institutions is 264.

4.1.2 *Demographics*

This subsection analyses the demographics, starting with gender. The gender distribution of the sample is shown in Figure 1.

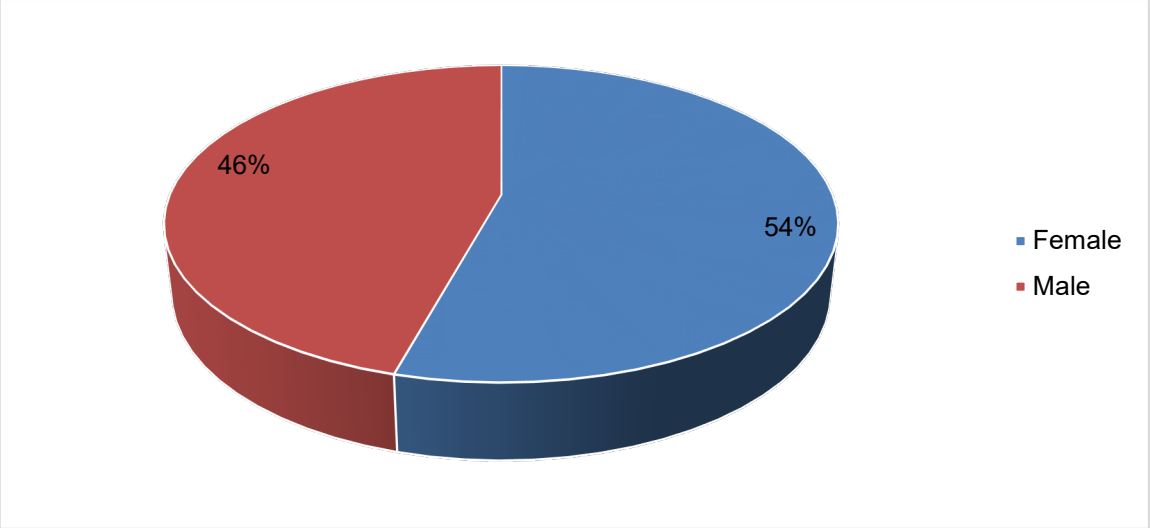


Figure 5: Respondent's gender profile

As seen in Figure 1, the majority of the participants were female at 54% while the other 46% of the respondents were male.

The figure below depicts the position held by the respondents

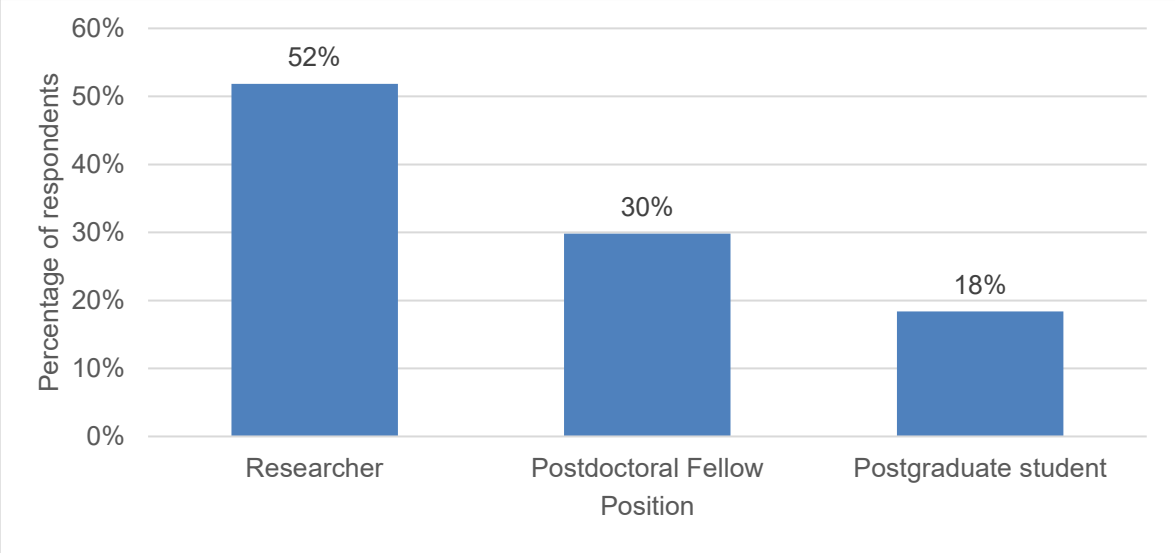


Figure 6: Respondent's positions

As seen in Figure 2, more than half of the respondents (52%) were researchers, followed by post-doctoral fellows at 30% and post-graduate students at 20%.

The initial population sample of the study was all the technology transfer offices in Gauteng but due to the time frame and no response to the survey sent, only the CSIR,

Vaal University of Technology and Wits University responded to the survey. The sample distribution by type of organisation is summarised in Figure 3.

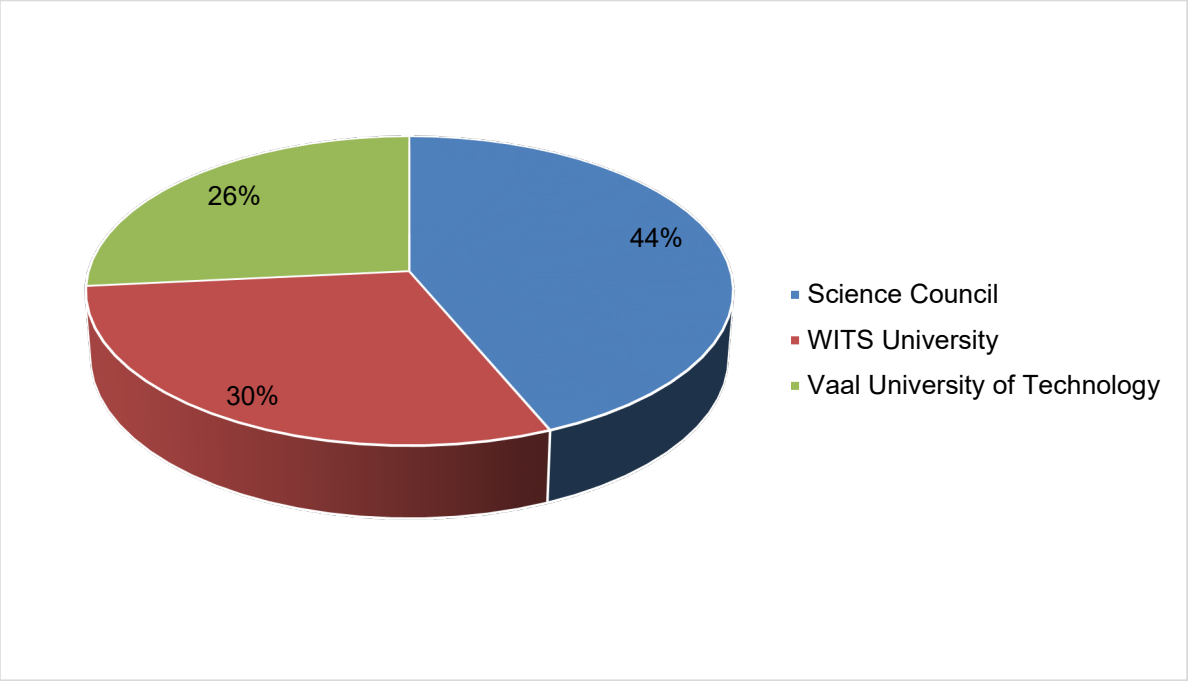


Figure 7: Respondents by type of organisation

As depicted in Figure 3, the highest proportions of respondents were from the CSIR (44%). The staff compliment of SET is 1200. The number gives 9% of the population sample response. WITS university responses constitute 30% of the total sample, which is 73 staff. From Vaal University of Technology, 65 staff members responded to the survey, which constituted 26% of the sample**.** The overall response rate of the survey is 12%.

The distribution of the sample by ethnic group is summarised in Figure 4.

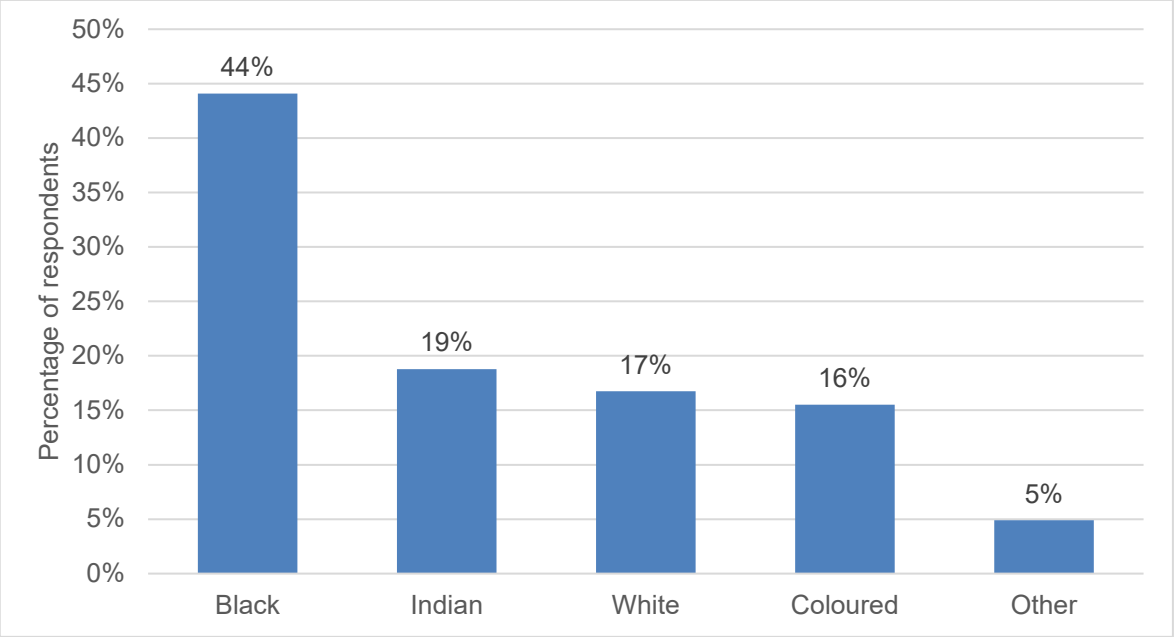


Figure 8: Respondents ethnicity

Regarding ethnicity, the majority of the respondents were Black at 44% followed by Indians at 19%, Whites at 17%, Coloureds at 16% and lastly, other races at 5%.

4.1.3 *Validity*

Exploratory Factor Analysis (EFA) was conducted to assess the validity of the constructs. The Kaiser–Meyer-Olkin (KMO) test was used to measure the sample adequacy, meaning that questions per construct should be enough to conduct analysis. The minimum value of a Kaiser-Meyer-Olkin should be more than 0.5.

Top management support for academic entrepreneurship (TP)

The items TP1 and TP2 were removed from the Top management support construct because they had low communality (<0.3). The resultant construct had five items and the results are shown in Table 3.

Table 3: Correlation Matrix - Top management support

		TP2	TP3	TP4	TP5	TP7
Correlation	TP2	1.000	.353	.229	.221	.230
	TP3	.353	1.000	.334	.300	.222
	TP4	.229	.334	1.000	.257	.213
	TP5	.221	.300	.257	1.000	.209
	TP7	.230	.222	.213	.209	1.000

The correlation matrix shows that there is some relationship among the items in the construct as required for factor analysis to work. The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and the Bartlett's Test of Sphericity results are summarised in Table 4;

Table 4: KMO and Bartlett's Test - Top management support

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.740
Bartlett's Test of Sphericity	Approx. Chi-Square	124.157
	df	10
	Sig.	.000

The requirement is that the KMO value should be at least 0.5 and the p-value should be significant (< 0.5). The results show that the KMO for Top management was 0.740, which was greater than 0.5 implying that the sample was good enough to run factor analysis The Bartlett's Test of Sphericity had a significant result (p-value = 0.000 < 0.05).

Table 5 shows the amount of variation in the original items that is explained by the retained factor.

Table 5: Total Variance Explained - Top management support

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.036	40.724	40.724	2.036	40.724	40.724
2	.821	16.428	57.152			
3	.791	15.824	72.976			
4	.743	14.857	87.832			
5	.608	12.168	100.000			
Extraction Method: Principal Component Analysis.						

It can be noted that the retained Top management support construct explains 40.724% of variation in the five items within the construct.

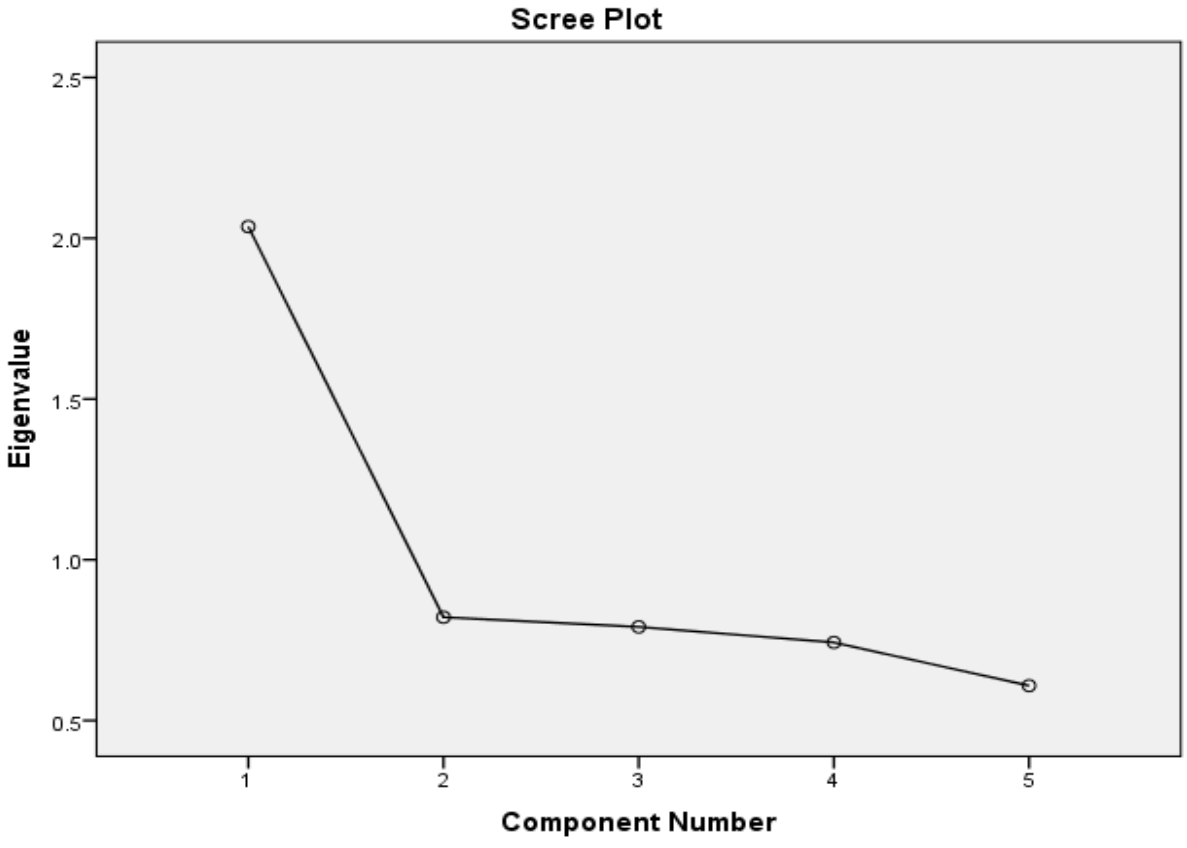


Figure 9: Scree Plot

The scree plot also confirms that there was one factor as loading shown by a steep slope from 1 to 2 and then the line flattens out. The component matrix, which shows the factor loadings is shown in Table 6.

Table 6: Component Matrix

Component Matrix[a]	
	Component
	1
TP3	.723
TP2	.643
TP4	.642
TP5	.617
TP7	.554
Extraction Method: Principal Component Analysis.	
a. 1 components extracted.	

All the five items loaded highly on to the one factor with factor loadings ranging from 0.554 to 0.723. The minimum acceptable factor loading is at least 0.4. Since all the five items were loading highly onto one factor, it can be concluded that the Top Management factor is valid with five items and not the originally hypothesised seven items.

Time Allocated for Innovation

The item TA5 was removed from the Time Allocated for Innovation construct during factor analysis as it had a communality less than 0.3. The Exploratory factor analysis results for the Rewards for the Innovation construct are summarised in the tables below.

Table 7: Correlation Matrix - Time Allocated for Innovation

Correlation Matrix					
		TA1	TA2	TA3	TA4
Correlation	TA1	1.000	.300	.271	.228
	TA2	.300	1.000	.191	.373
	TA3	.271	.191	1.000	.139

	TA4	.228	.373	.139	1.000

The results in the correlation matrix show that there is some relationship among the items in the construct as required for factor analysis to work. The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and the Bartlett's Test of Sphericity results are summarised in Table 8;

Table 8: KMO and Bartlett's Test - Time Allocated for Innovation

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.650
Bartlett's Test of Sphericity	Approx. Chi-Square	85.570
	df	6
	Sig.	.000

The KMO value was 0.650, which was greater than the minimum required value of 0.5. This implies that the sample was good enough to run a factor analysis. The Bartlett's Test of Sphericity had a significant result (p-value = 0.000 < 0.05).

Table 9 shows results on the total variance in the individual items that is explained by the retained factor.

Table 9: Total Variance Explained - Time Allocated for Innovation

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.761	44.018	44.018	1.761	44.018	44.018
2	.918	22.954	66.973			
3	.706	17.660	84.633			
4	.615	15.367	100.000			
Extraction Method: Principal Component Analysis.						

The retained factor for the Time Allocated for Innovation construct explained 44.018% of variation in the four items retained in the construct. The scree plot below confirms that there was one factor retained.

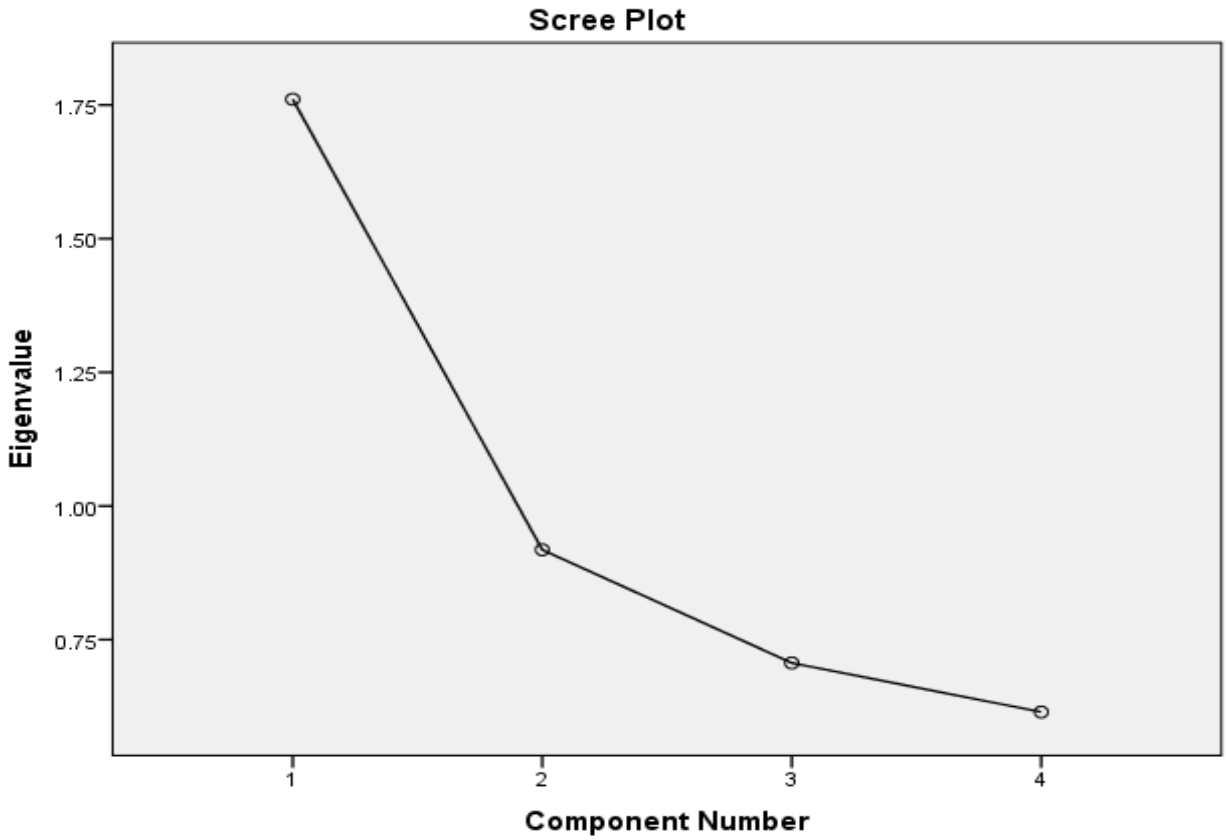


Figure 10: Scree plot - Time availability

The scree plot confirms that there was one factor as shown by a steep slope from 1 to 2 and then the line flattens out. The component matrix, which shows the factor loadings, is shown in Table 10.

Table 10: Component Matrix - Time availability

Component Matrix[a]	
	Component
	1
TA2	.736
TA1	.686
TA4	.667
TA3	.551
Extraction Method: Principal Component Analysis.	

a. 1 component extracted.

The results revealed that all four items retained in the construct loaded highly onto the one factor with factor loadings ranging from 0.551 to 0.736. These values were all above the minimum acceptable factor loading of 0.4. This implies that the retained factor for Time availability was valid.

Rewards for Innovation

Exploratory factor analysis results for the Rewards for Innovation construct are summarised in the tables below.

Table 11: Correlation Matrix - Rewards for Innovation

Correlation Matrix								
		RS1	RS2	RS3	RS4	RS5	RS6	RS7
Correlation	RS1	1.000	.420	.335	.160	.345	.192	.352
	RS2	.420	1.000	.408	.181	.311	.332	.291
	RS3	.335	.408	1.000	.188	.339	.345	.225
	RS4	.160	.181	.188	1.000	.292	.299	.244
	RS5	.345	.311	.339	.292	1.000	.369	.219
	RS6	.192	.332	.345	.299	.369	1.000	.281
	RS7	.352	.291	.225	.244	.219	.281	1.000

The correlation matrix shows that there is some relationship among the items in the construct as required for factor analysis to work. The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and the Bartlett's Test of Sphericity results are summarised below;

Table 12: KMO and Bartlett's Test - Rewards for Innovation

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.800
Bartlett's Test of Sphericity	Approx. Chi-Square	296.614

	Df	21
	Sig.	.000

The KMO value was 0.800, which was greater than the minimum required value of 0.5. This implies that the sample was good enough to run a factor analysis. The Bartlett's Test of Sphericity had a significant result (p-value = 0.000 < 0.05).

Table 13 shows the results of the total variance in the individual items that is explained by the retained factor.

Table 13: Total Variance Explained - Rewards for Innovation

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.768	39.544	39.544	2.768	39.544	39.544
2	.965	13.784	53.328			
3	.845	12.071	65.399			
4	.714	10.200	75.599			
5	.640	9.149	84.748			
6	.580	8.293	93.040			
7	.487	6.960	100.000			
Extraction Method: Principal Component Analysis.						

It can be noted that the Rewards for Innovation construct explained 39.544% of variation in the seven items retained in the construct. The scree plot below confirms that there was one factor retained.

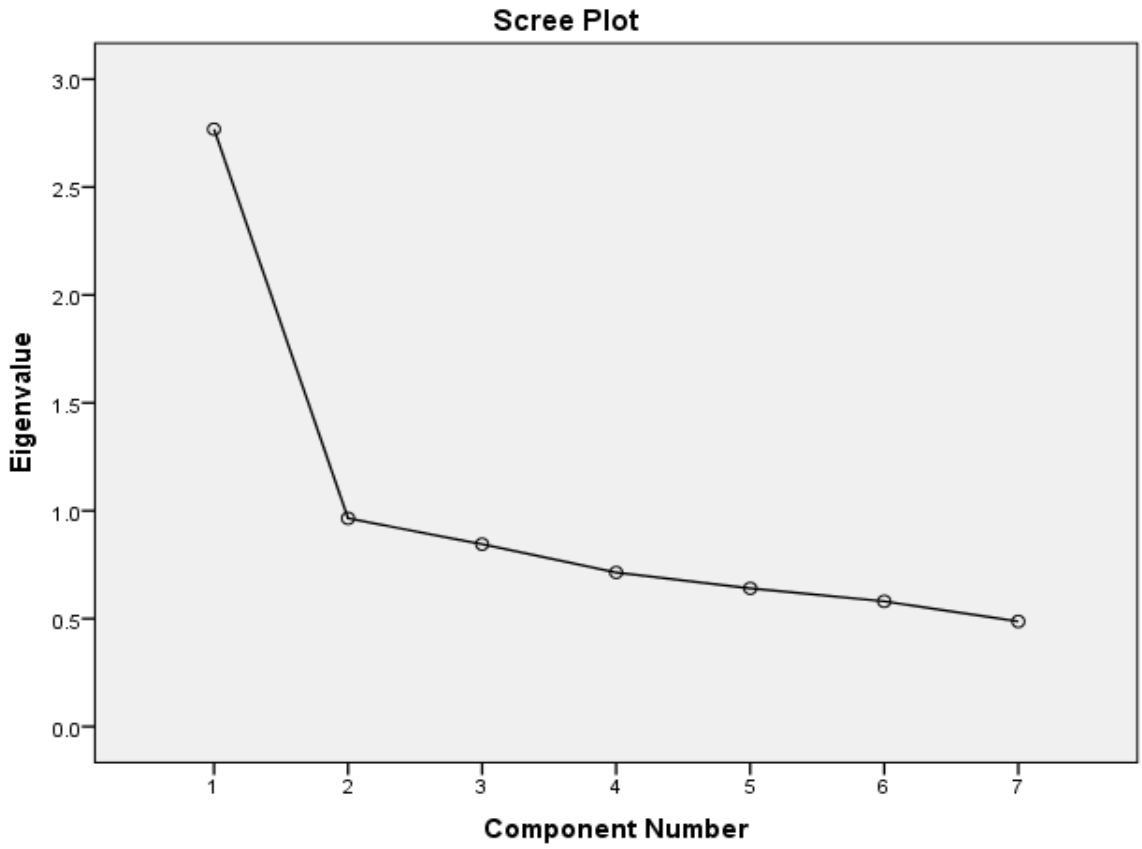


Figure 11: Scree plot - Rewards for Innovation

The scree plot confirms that there was one factor as shown by a steep slope from 1 to 2 and then the line flattens out. The component matrix, which shows the factor loadings is shown in Table 14.

Table 14: Component Matrix - Rewards for Innovation

	Component
	1
RS2	.690
RS5	.662
RS3	.661
RS1	.648
RS6	.643
RS7	.579
RS4	.497
Extraction Method: Principal Component Analysis.	

a. 1 component extracted.

All seven items loaded highly on to the one factor with factor loadings ranging from 0.497 to 0.690, which were all greater than the minimum acceptable factor loading of at least 0.4. Since all seven items were loading highly onto one factor, it can be concluded that the rewards factor is valid with seven items as originally hypothesised.

Reliability

The reliability test was conducted on the instruments using the Cronbach's alpha. When analysing using Cronbach's alpha, the value has to be above 0.7 for the instrument to be used for further analysis. The reliability of the test means that the questionnaire used consistently measured the construct it is meant to measure.

Table 15: Reliability Level

Construct	Number of Items	Cronbach's Alpha	Reliability Level
Top Management Support	5	0.629	Questionable
Time Allocated for Innovation	4	0.568	Poor
Rewards for Innovation	7	0.739	Acceptable

Rewards for Innovation (α = 0.739) had an acceptable level of reliability since the Cronbach's Alpha was greater than 0.7. The reliability test for Time Allocated for Innovation (α = 0.568) and Top Management Support (α = 0.629) has values lower than the required value of at least 0.7. This is despite the fact that the Time Allocation instrument was used before by Hornsby, Kuratko, Holt, and Wales (2013) in a corporate entrepreneurship context.

Field (2009) asserts that a value less than 0.7 can be expected when dealing with psychological constructs and in fact, Nunnaly (1978) argued that even as low as 0.5 can be expected. In light of this argument, even though the Cronbach's Alpha values for Time Allocation and Top Management were less than 0.7, data analysis continued.

Since the Cronbach's Alpha values were greater than 0.5, the items within each scale could be combined to form a summated scale for the construct. The summated scale

was computed by calculating the average of the items within the construct. The descriptive statistics and Pearson's correlations for the constructs is summarised below.

Table 15: Reliability level

			Pearson's Correlation				
	Mean	Std. Deviation	1.	2.	3.	4.	5.
1.Resource Support	4.19	1.05	1				
2.Top Management	4.06	1.09	.577**	1			
3.Time Availability	4.19	1.03	.601**	.498**	1		
4.Academic Entrepreneurship	32.49?	32.30?	.326**	.213**	.140*	1	
5.Start-Ups	3.34	1.64	.444**	.331**	.232**	.919**	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Pearson's correlation has been widely used to test the relationship between variables. If the value of the Pearson is +1, this means that the variables have a positive relationship and -1 value means there is a negative relationship between the tested constructs.

The Pearson's correlation coefficients shows that there was a significant positive relationship between Academic Entrepreneurship and each of the Resource Support ($r = 0.326$, p-value < 0.01), Top Management ($r = 0.213$, p-value < 0.01) and Time Availability ($r = 0.140$, p-value < 0.05). Since the correlations among the independent variables were not very high (> 0.8), this means that there is no problem of multicollinearity.

Normality test

The value of the Kolmogorov-Smirnov has to be more than 0,05 for a variable to be considered to be normally distributed. The normality test values are summarised below.

Table 16: Kolmogorov-Smirnov - Test for normality

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
Resource Support	.112	245	.000
Top Management	.081	245	.001
Time Availability	.090	245	.000
Academic Entrepreneurship	.348	245	.000
Start Ups	.280	245	.000
a. Lilliefors Significance Correction			

The values of all the constructs are below 0.05 which means that the data is not normally distributed. Some of the reasons cited in the literature for data not normally distributed is sensitivity to sample size. The size study was meant to collect data from seven institutions but only three institutions responded. This could explain the sensitivity to normality that is attributed to sample size.

A multiple regression model was fitted with Log Academic Entrepreneurship as the dependent variable and Resource Support, Top Management and Time Availability as the independent variables. Academic Entrepreneurship was transformed to the natural logarithmic of Academic Entrepreneurship + 1, labelled as Log Academic Entrepreneurship. This is because the Academic Entrepreneurship variable was producing error terms that were not close to the normal distribution.

Table 17: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.448[a]	.200	.190	.68469	.281
a. Predictors: (Constant), Time Allocation, Top Management, Resource Support					
b. Dependent Variable: Log_Academic Entrepreneurship					

The results indicate that Time Allocation, Top Management, Resource Support explains 20% of variation in Academic Entrepreneurship as indicated by an r-square value of 0.200.

The results shown in ten ANOVA table tests the null hypothesis that none of Time Allocation, Top Management, Resource Support is significant in predicting Academic Entrepreneurship against the alternative hypothesis that at least one of the independent variables is significant in predicting Academic Entrepreneurship. The results are shown in the ANOVA Table.

Table 18: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	28.324	3	9.441	20.139	.000[b]
	Residual	112.981	241	.469		
	Total	141.306	244			
a. Dependent Variable: Log_Academic Entrepreneurship						
b. Predictors: (Constant), Time Allocation, Top Management, Resource Support						

It can be noted from an F-value of 20.139 and a p-value of 0.000 < 0.05 that at least one of the independent variables is significant in predicting Academic Entrepreneurship. This is because the p-value of the f-test was less than 0.05. The results shown in the coefficients table below shows which individual independent variable is significant in predicting Academic Entrepreneurship.

Table 19: Regression Coefficients

Coefficients[a]								
Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.715	.210		3.400	.001		
	Resource Support	.301	.057	.415	5.280	.000	.536	1.866
	Top Management	.087	.051	.124	1.710	.089	.631	1.585

	Time Allocation	-.065	.055	-.088	-1.184	.238	.604	1.655
a. Dependent Variable: Log_Academic Entrepreneurship								

Testing of Validity of the model

The null hypotheses, is that all the coefficients of the independent variables are equal to zero:

That is, $H_0: B_1 = B_2 = B_3 = 0$

The alternative hypothesis is that at least one coefficient is not equal to zero:

That is, $H_1: At\ least\ one\ B_i \neq 0, for\ i = 1, 2,3$

The model is said to be invalid if the null hypothesis is true. It can be noted from the ANOVA table that the p-value of the F test was 0.000. This implies that the null hypothesis is rejected at 5% significance level and it is concluded that the model is valid since at least one of the B_is is not equal to zero.

Testing the Coefficients

For each of the independent variables, a test is conducted for (i = 1, 2 and 3).

$H_0: B_i = 0$

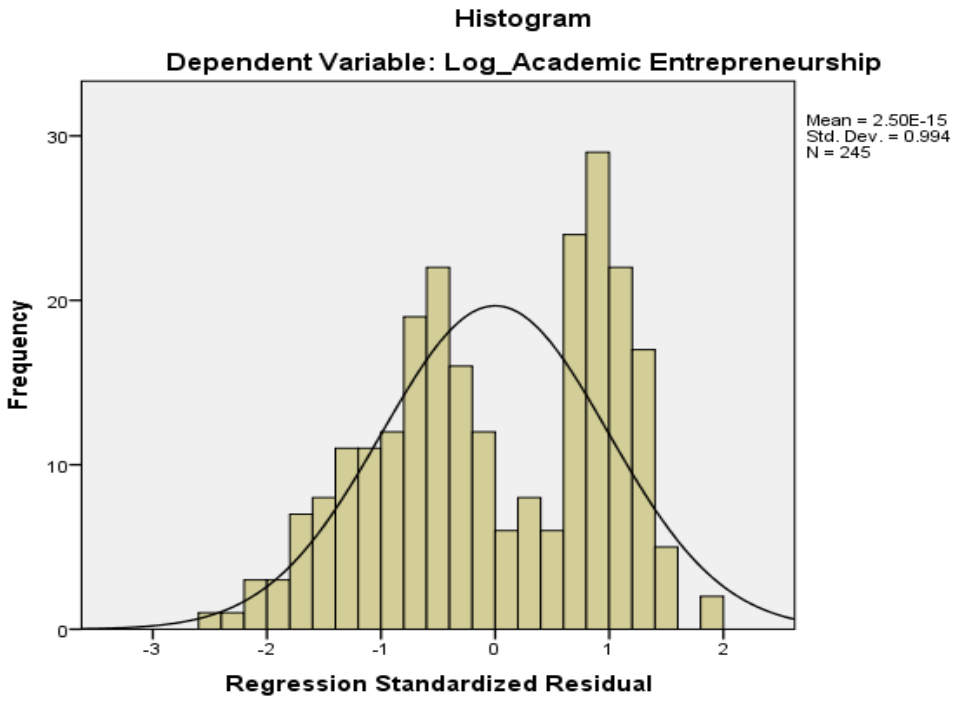
$H_1: B_i \neq 0$

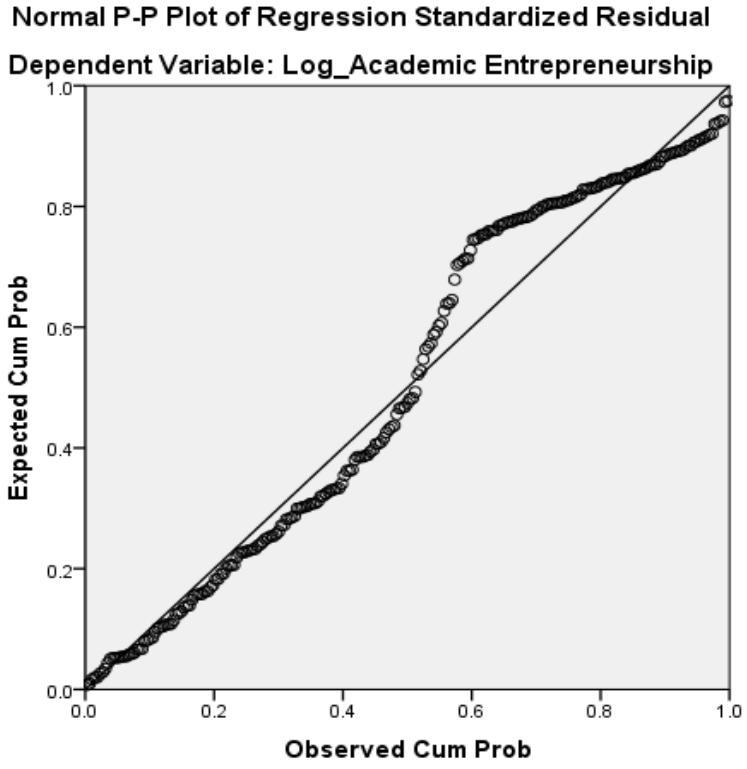
Table 20: Coefficients testing

Variable	Coefficient	P-value
Resource Support	B_1	.000
Top Management	B_2	.089
Time Allocation	B_3	.238

It can be noted that there is sufficient evidence to suggest that Resource Support (p-value = 0.000) was linearly related to Log Academic Entrepreneurship. On the other hand, Top Management (p-value = 0.089) and Time Allocation (p-value = 0.238) were not linearly related to Log Academic Entrepreneurship.

Testing for violation of error term conditions

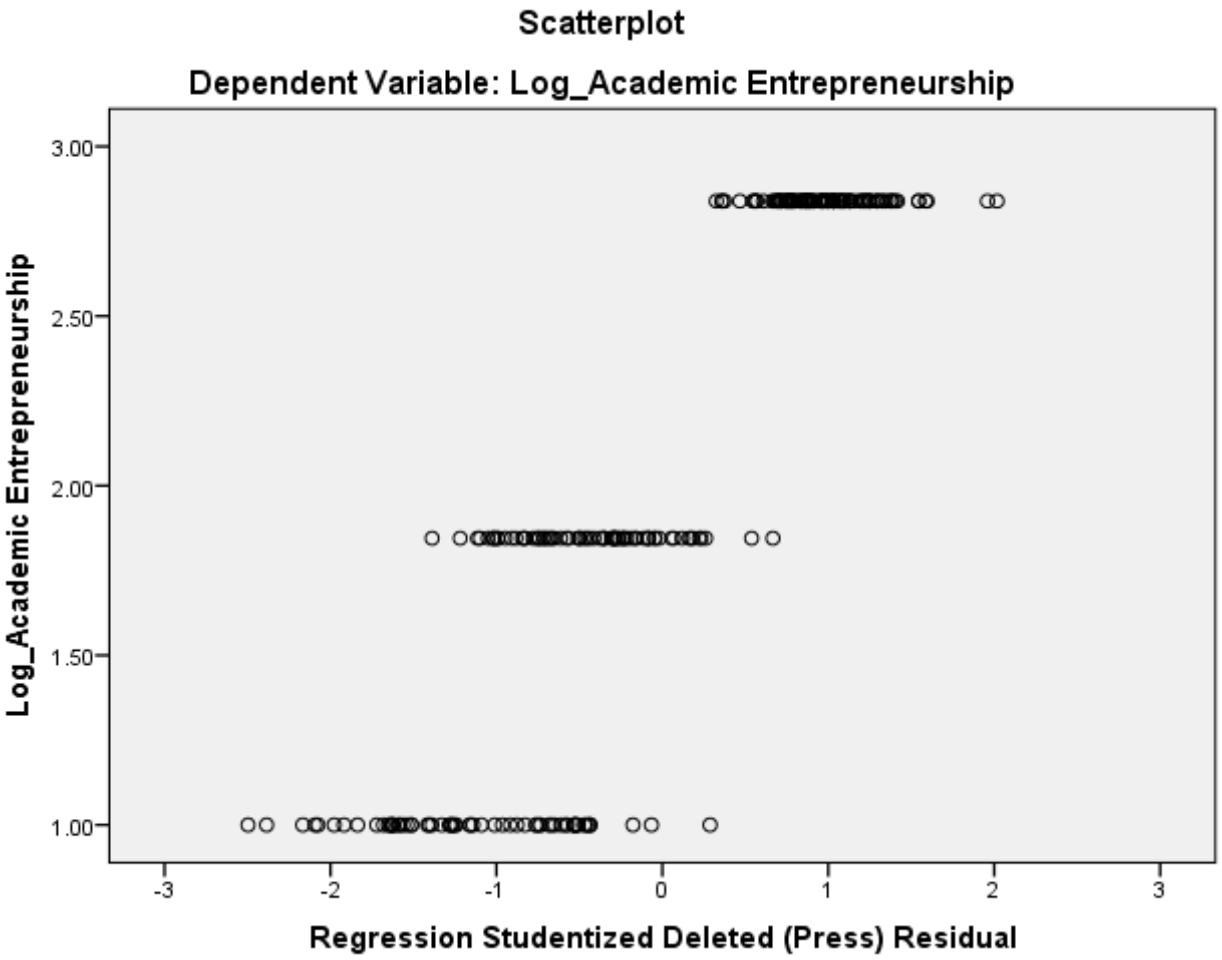

Histogram
Dependent Variable: Log_Academic Entrepreneurship
Mean = 2.50E-15
Std. Dev. = 0.994
N = 245
Frequency
Regression Standardized Residual


Normal P-P Plot of Regression Standardized Residual
Dependent Variable: Log_Academic Entrepreneurship
Expected Cum Prob
Observed Cum Prob

The histogram is almost bell-shaped showing that the residuals were normally distributed as required for regression. The Normal P-P plot of standardised residuals also shows values very close to the diagonal line, this suggests that the residuals are normally distributed.

Heteroscedasticity

The error terms were plotted against the fitted values to assess whether there is any pattern in the error terms. The requirement is that the error terms should not show any pattern as they should be constant, a condition called homoscedasticity.



The error terms did not show any pattern besides the fact that the Academic Entrepreneurship was from three institutions and thus was on three positions as well on log-academic entrepreneurship as expected.

Test for Multicollinearity

From the coefficients table, it can be noted that the VIF values were all less than 10, this implies that there was no problem of multicollinearity.

The conditions for fitting a regression model were not violated. The regression model in this case is;

$$\hat{y} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3$$

where, $\hat{y}$ is the predicted value for Log Academic Entrepreneurship, x_1 is Resource Support, x_2 is Top Management and x_3 is Time Allocation. This means that the model is;

$$\hat{y} = .715 + 0.301\, x_1 + 0.087 x_2 - 0.065 x_3$$

4.2 Results pertaining to Hypothesis 1

The results in table 17 show that there is no significant relationship between academic entrepreneurship and top management support (B =0.087, β = 0.124, t-value = 1.710, p-value = 0.631). The relationship is not significant because the p-value was greater than 0.05. It is therefore concluded that there is no relationship between top management support and academic entrepreneurship.

4.3 Results pertaining to Hypothesis 2

The results in table 17 show that there is a positive significant relationship between rewards (B =0.301, β = 0.415, t-value = 5.280, p-value = 0.001) and academic entrepreneurship. The relationship is positive because the coefficient for rewards/ resource support is positive and is significant because the p-value was less than 0.05. Therefore, it is concluded that there is a positive relationship between rewards and academic entrepreneurship.

4.4 Results pertaining to Hypothesis 3

The results in table 17 shows that there is no significant relationship between academic entrepreneurship and Time Allocation (B =-0.065, β = -0.088, t-value = -1.184, p-value = 0.238). The relationship is not significant because the p-value was greater than 0.05. It is therefore concluded that there is no relationship between Time Allocation and academic entrepreneurship.

4.5 Conclusion of the results

A summary of the results showed that the reliability of the scale on one construct, rewards for academic entrepreneurship and low, but acceptable, reliability of top management support and time allocation constructs. The presentation of the results also showed descriptive statistics, normality test and factor analysis. The hypothesis was tested using correlation and regression test. As explained above, there is a positive relationship between academic entrepreneurship and rewards for academic entrepreneurship. There is however no relationship between academic entrepreneurship and each of top management support and Time Allocation.

CHAPTER 5. DISCUSSION OF THE RESULTS

5.1 Introduction

Chapter 4 presented the results and this chapter discusses the results. The discussion is explained against theoretical statements that were discussed in Chapter 2. Demographics of the study are briefly discussed, followed by the scrutiny of results of the hypotheses that were proposed and a conclusion of the chapter.

5.2 Descriptive profile of the study sample

The data for the study was collected using an online survey. Because the response was not sufficient and it was difficult to achieve enough data to analyse, another method was considered which involved distributing hard copies to the respondents. This approach assisted in getting enough numbers to run statistical analysis. A total number of 264 questionnaires were completed.

5.2.1 *Demographic profile of respondents*

This discussion of demographics looks into the gender, position, ethnicity and institutions. The research sample was made up of researchers, post-doctoral fellows and post-graduate students at the CSIR, Wits and Vaal University of Technology. The responses received from CSIR were 44% from the science council, 30% from the university and 26% from the university of technology. The response rate from science council is 10 per cent of the total number of SET staff**.** The response is lower than anticipated, but it is accepted because surveys as a method of collecting data, is generally a challenge. Regarding gender, most of the respondents are female at 54% with males at 46%.

The sample size included post-doctoral fellows, and post-graduate students and researchers. Even though the post-doctoral students and post-graduates are not "permanent" staff in the institutions, it was important to include them as they form part of the research teams that engage in academic entrepreneurship. The research

conducted by post-docs and post-graduates could lead to ideas that can have a technology transfer potential and therefore it is important to understand their perception on the hypothesised constructs. The results show that the majority of respondents are researchers at 52%, followed by post-doctoral fellows at 30% and post-graduate students at 18%.

5.2.2 *Exploratory Factor analysis*

The Principal Axis Factoring approach was used to test the factor loading of the scale items. Using the Kaiser-Meyer-Olkin (KMO) test, two constructs from Top Management were removed because they had low communality. The remaining questions were enough to measure the construct. The construct had KMO of 0.740 which is acceptable to measure a construct and the Bartlett test of significance was 0.000 which is a good indicator that scales can be used for factor analysis.

With regards to time allocation for academic entrepreneurship construct, only one question had a low communality and was removed from the scale. The KMO test showed some relationship among the items with a value of 0.650 and Bartlett test of 0.000. The results were accepted but it is worth noting that the items were tested by Hornsby, Kuratko, Holt, and Wales (2013) and the results showed excellent reliability when measuring the construct for corporate entrepreneurship.

All the items for rewards for academic entrepreneurship construct were retained. The KMO value was 0.8 which showed excellent value and Bartlett's test of 0.000 significance, which means that the items were adequate to measure the construct.

5.2.3 *Reliability*

Rewards for Innovation (α = 0.739) had an acceptable level of reliability since the Cronbach's Alpha was greater than 0.7. The reliability test for Time Allocated for Innovation (α = 0.568) and Top Management Support (α = 0.629) has values lower than the required value of at least 0.7. This is despite the fact that the Time Allocation

instrument was used before Hornsby, Kuratko, Holt, and Wales (2013) in a corporate entrepreneurship context.

5.3 Discussion pertaining to Hypothesis 1

The study looked at the relationship between top management and academic entrepreneurship to determine if they have a relationship.
Firstly, we look at the relationship between the start-up and the top management and rewards.

The hypothesis is

$H_{0:}$ There is no relationship between top management support and academic entrepreneurship

H_{1}*:* There is a positive relationship between top management support and academic entrepreneurship

The results show a significant relationship of r=0.213 with a significance of 0.01 between top management support and academic support. If the correlation is +1, it means there is a positive relationship between two variables. Based on this value, we can confirm that there is a relationship between top management and academic entrepreneurship, but it is very low.

The study further looked at the regression model to test the level of causality of the independent construct to the dependent variable. The test showed a B =0.087, β = 0.124, t-value = 1.710, p-value = 0.631, which means that the top management support has no causal effect on academic entrepreneurship because the significance is more than 0.005.

Nyatlo (2015) asserted that most inventions are not disclosed because the researchers do not feel obliged by their managers to disclose and that most institutions cited lack of buy-in from top management and fellow researchers. Nyatlo (2015), citing Gharajedaghi

(2006), emphasised that a challenge for the technology transfer office is the culture that guides the universities and it either promotes or impedes disclosure of IP which is the first step of the technology transfer process.

Even though literature has suggested a positive relationship between the top management support for academic entrepreneurship and academic entrepreneurship, the results concluded that there is no relationship and therefore the null hypothesis is accepted.

5.4 Discussion pertaining to Hypothesis 2

The hypothesis is

$H_{0:}$ There is no relationship between rewards and academic entrepreneurship

H_1: There is a positive relationship between rewards and academic entrepreneurship

The Pearson's correlation testing the relationship between the variables was 0.326 between the academic entrepreneurship and rewards which is a positive relationship. Based on these, we can therefore conclude by accepting the alternative hypothesis. This is in line with assertions made in Huyghe and Knockaert (2014) that aligning rewards and incentives with commercialisation activities promotes academic entrepreneurship.

The study further looked at the regression model to see the test the level of causality of the independent construct to the dependent variable. The test showed (B =0.301, β = 0.415, t-value = 5.280, p-value = 0.001), which means that the rewards for academic entrepreneurship has a causal effect on academic entrepreneurship because the significance is more than 0.005. From this test we can then say that an increase in one unit of rewards will increase academic entrepreneurship by 41%.

This confirms the assertion of Kirby (2005) that the faculties with a higher entrepreneurial culture have more academics engaging in entrepreneurial activities. For institutions to experience an increase in academic entrepreneurship, there needs to be

a culture and climate that is conducive because the primary role of academics for years has been teaching and research not entrepreneurial thinking (Kirby, 2005).

The findings of Nyatlo (2015) in her thesis revealed that although technology transfer offices were established to champion the objectives of the act in universities, the universities could still be motivated by recognition of the academic output and additional income from technology transfer activities. She further pointed out that technology transfer activities do not, as yet, acknowledge the importance of promotion based on technology transfer activities.

These results suggest that rewards have an effect on academic entrepreneurship, and institutions, which have not considered aligning the two variables, should look into that.

5.5 Discussion pertaining to Hypothesis 2

The hypothesis is

$H_{0:}$ There is no relationship between time allocation and academic entrepreneurship

H_1: There is a positive relationship between time allocation and academic entrepreneurship

The Pearson's correlation value was 0.140 between the academic entrepreneurship and time allocation, which is significantly low. The results from the regression model showed (B =-0.065, β = -0.088, t-value = -1.184, p-value = 0.238).

As discussed in Chapter 2, literature suggests that time allocation for academic entrepreneurship activities is as important as time allocated for academic activities. Renault (2006) argues this point by asserting that as long as intellectual property and institution policies are not aligned, researchers will be reluctant to focus on these

activities and that scholarly contribution should have equal weighting as licencing and spin-off activities.

From these results, we can therefore accept the null hypothesis which says that there is no relationship between time allocation and academic entrepreneurship.

CHAPTER 6. CONCLUSIONS & RECOMMENDATIONS

6.1 Introduction

This study sought to contribute to the knowledge and literature on academic entrepreneurship by looking at organisational preparedness for academic entrepreneurship that it defined as activities that have an element of risk, but may lead to commercialisation. The research then looked at the antecedents of academic entrepreneurship of three constructs to see if they encourage academic entrepreneurship. Two constructs were tested; top management and rewards and the results showed that there is a relation between these independent variables and the dependent variable of academic entrepreneurship. These results will assist research institutions that have not renewed their strategy to consider this.

6.2 Conclusions of the study

The reliability test for Time Allocated for Innovation ($\alpha = 0.568$) and Top Management Support ($\alpha = 0.629$) has values lower than the required value of at least 0.7. This is despite the fact that the Time Allocation instrument was used before by Hornsby, Kuratko, Holt, and Wales (2013) in a corporate entrepreneurship context. The instrument showed a low value of reliability for time allocated and top management support. This might have had an effect on the study results as this showed the instrument was not measuring the construct reliably. Despite this instrument being used in corporate entrepreneurship, a new instrument to measure academic entrepreneurship is proposed.

From the results of Hypothesis 1, the correlation results showed a very low positive relationship between top management support and academic entrepreneurship with a correlation coefficient value of 0.213.

Hypothesis 2 results showed a positive relationship between rewards and academic entrepreneurship. The value of the correlation was 0.326. This depicts a positive relationship since correlation is 0.326 and there is a significant relationship between the two variables since p-value is less than 0.05.

Lastly, Hypothesis 3 results showed a Pearson's correlation value of 0.140 for time allocation and academic entrepreneurship. The value of the correlation was 0.140 which depicts a positive relationship, albeit of a very low value.

From the regression model, only rewards for incentives showed a causal effect on the academic entrepreneurship with a value of B =0.301, β = 0.415, t-value = 5.280, p-value = 0.001. Time allocation and Top Management hypotheses were rejected.

6.3 Implications of the study and recommendations

This study contributes to the body of literature that exists in South Africa looking at the antecedents of academic entrepreneurship in government funded research institutions by asking for perceptions of the researchers on top management support, time allocation and rewards and incentives for academic entrepreneurship. This study focused on the individual-institution nexus that drives academic entrepreneurship.

The results of this study could be used by other institutions to decide on what changes can be effected to encourage entrepreneurial culture. For the research and higher education institutions to fulfil and improve their contribution to the economic development and global competitiveness through exploitation of research output there should be a renewal of the strategy to accommodate the third mission.

Looking at the results recently published on the IPRACT survey published by the DST and NIPMO, there has been an increase on the pace of the licences and start-ups created since promulgation of the Act but there is much room to increase the impact.

Even though these results can assist institutions to align their strategy with academic entrepreneurship, these results cannot be generalised and replication of this study might not yield the same results in a different context.

From the literature review presented, it can be suggested that top management through university managers and technology transfer offices have a crucial role to play in developing an entrepreneurial culture and climate through formal and informal institutional frameworks by providing support for academic entrepreneurship.

6.4 Further research recommendation

This study focused on the organisational preparedness of institutions to embrace academic entrepreneurship. The instrument that was used to measure the constructs has been previously tested for reliability and validity on corporate entrepreneurship but when the scale was employed on academic entrepreneurship, it did not yield good results in terms of reliability and validity. A scale that is designed to measure academic entrepreneurship, specifically organisational preparedness, will be useful.

Secondly, the study only looked at three institutions in Gauteng. A study that would focus on all the institutions that are publicly funded to do research is recommended for further studies, as this will give an indication of the progress institutions have made to advance their commitment to the object of the Act.

Lastly, this study only focused on time allocation, top management support and rewards for academic entrepreneurship. For further research, a study focusing on funding allocation to see whether researchers are allocated funding for their academic entrepreneurial activities, comparative study of commercialisation models that could be used to increase academic entrepreneurship and external ecosystem that encourages commercialisation of intellectual property from government funded research institutions could be conducted.

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APPENDIX A

Dear Researcher,

My name is Siyanda Gamata, a Masters of Management in Entrepreneurship and New Venture Creation at the University of Witwatersrand Business School (Wits Business School), Johannesburg. My MM research title is: **"Organisational preparedness for academic entrepreneurship: A focus on science organisations and universities in South Africa".** The overall objective of the research is to assess organisational preparedness for academic entrepreneurship since the promulgation of Intellectual Property Rights Act on Public Funded Institutions in August 2010.

As a researcher, you play a crucial role in academic entrepreneurship; you are invited to participate in my research by completing the accompanying questionnaire. The questionnaire is divided into three sections each designed to collect data on different variables as described below. Section 1 asks questions about top management support for academic entrepreneurship. Section 2 asks questions rewards and incentives for engaging in academic entrepreneurship. Section 3 asks questions on time allocation to work on academic entrepreneurship activities.

The questionnaire consists of 15 questions and should take you about 5 minutes to complete.

The research study was approved unconditionally by the Wits Business School research panel. Should you have queries related to the research, please feel free to contact my supervisor: Prof Boris Urban on boris.urban@wits.ac.za.

You may directly request copies of the results of the research to me on 082 660 7604 or 1277366@students.wits.ac.za/ mantombiza@gmail.com.

Thanking you in advance for your participation.

Siyanda Gamata

1. **Demographics**

What is your ethnicity?

- ○ Indian
- ○ Coloured
- ○ Black
- ○ White
- ○ Other

Gender

- ○ Female
- ○ Male

Type of institution

- ○ University of Technology
- ○ University
- ○ Science Council

Position

○ Postgraduate Student

○ Postdoctoral Fellow

○ Researcher

Questions	**Strongly Disagree**	**Slightly disagree**	**Disagree**	**Not sure**	**Agree**	**Slightly Agree**	**Strongly Agree**
Top Management Support: defined as the willingness of top-level managers to facilitate and promote entrepreneurial behaviour, including the championing of innovative ideas and providing the resources people require to take entrepreneurial actions							
Upper management is aware and very receptive to my ideas and suggestions							
This business unit supports many small and experimental projects realizing that some will undoubtedly fail							
Money is often available to get new							

project ideas off the ground							
People are often encouraged to take calculated risks with new ideas around here							
Senior managers encourage innovators to bend rules and rigid procedures in order to keep promising ideas on track							
Those employees who come up with innovative ideas on their own often receive management support for their activities							
My manager helps me get my work done by removing obstacles							
Rewards/Reinforcement: refers to developing and using systems that reward based on performance, highlight significant achievements, and encourage pursuit of challenging work							
The rewards I receive are dependent upon							

my innovation on the job							
My supervisor will give me special recognition if my work performance is especially good							
My manager would tell his/her boss if my work was outstanding							
My rewards are determined by teaching and research performance on publications							
My rewards are based on involvement in consulting and contract activities							
My rewards are based on my involvement in patenting and licensing							
Promotion usually follows the commercialising of innovative ideas							

Time availability: refers to evaluating workloads to ensure that individuals and groups have the time needed to pursue innovations and that their jobs are structured in ways that support efforts to achieve short-and long-term organisational goals							
I always seem to have plenty of time to get everything done							
During the past three months, my workload was too heavy to spending time on developing new ideas							
I have just the right amount of time and workload to do everything well							
I feel that I am always working with time constraints on my job							
My co-workers and I always find time for long-term solving							

Appendix B : Consistency Matrix

Sub problem	**Literature review**	**Hypothesis or propositions or research questions**	**Analysis**
Assess the top management support for academic entrepreneurship	(Guerrero & Urbano, 2012) (Kirby D. A., 2005) (Etzkowitz, 2003) (Hornsby, Kuratko, Holt, & Wales, 2013) (Bercovitz & Feldman, 2008) (Kirby, Urbano, & Guerrero, 2011)	Top management support for academic entrepreneurship has positive relationship and academic entrepreneurship	Correlation and regression analysis
Assess if the organisation rewards innovativeness	(McInnis, 2001) (Huyghe & Knockaert, 2014)	There is positive relationship between rewards and academic entrepreneurship	Correlation and regression analysis
Evaluate researchers time allocation for innovative ideas	(Hornsby, Kuratko, Holt, & Wales, 2013; Huyghe & Knockaert, 2014)	There is a positive relationship between time allocated and academic entrepreneurship	Correlation and regression analysis