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Rebalancing innovation policy mix to improve support for South Africa's manufacturing sector

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Abstract

Innovation has long been established as a cornerstone of economic growth, and governments use a mixture of innovation policy instruments to achieve the economic and social goals of a country. South Africa's manufacturing sector has seen a contraction in 2015. The manufacturing sector is particularly driven by innovation, and this study examines how South Africa's innovation policy mix needs to be rebalanced in order to achieve growth in the sector.

The study is approached using quantitative methods to characterise and compare South Africa's innovation policy mix to two comparator countries. Canada was chosen as an example of a developed country, and India as an example of an emerging nation. The effectiveness of South Africa's innovation policy mix is then evaluated using qualitative methods and the results applied to show how South Africa's innovation policy mix could be reconfigured to achieve economic growth.

It was found that South Africa's policy mix is dominated by supply-side measures. India and Canada have applied a combination of supply-side and demand-side innovation policy measures to achieve goals that are comparable to South Africa's. It was also found that a chasm existed between policy instruments that support research and development efforts and the instruments that support market development. Rebalancing the innovation policy mix towards using more demand-side instruments and more generic rather than population targeted instruments could provide a remedy to this problem and improve the prospects for the sector.

Keywords: Innovation Policy Mix; Research and Development; Economic Growth; Government Policy; Policy Making; Mixed Methods

Declaration

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

Shahendra Naidoo

Date

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List of Abbreviations

12I	Section 12I Tax Allowance Incentive
AIS	Automotive Incentive Scheme
BBSDP	Black Business Supplier Development Programme
CAQDAS	Computer-Aided Qualitative Data Analysis Software
CIP	Critical infrastructure Programme
CPFP	Capital Projects Feasibility Programme
CTICIP	Clothing and Textile Competitiveness Improvement Programme
DHET	Department of Higher Education and Training (DHET)
DoE	Department of Education
DST	Department of Science and Technology
DUI	Doing, Using and Interacting
EMIA	Export Marketing and Investment Assistance
GDP	Gross Domestic Product
MCEP	Manufacturing Competitiveness Enhancement Programme
NACI	National Advisory Commission on Innovation
NRF	National Research Foundation
NSI	National System of Innovation
OECD	Organisation for Economic Co-operation and Development
P-AIS	People-Carrier Automotive Incentive Scheme
PPP	Public-private partnership
R&D	Research and Development
RD&I	Research, Development and Innovation
seda	Small Enterprise Development Agency
SPII	Support Programme for Industrial Innovation

SSAS	Sector-Specific Assistance Scheme
STI	Science, Technology and Innovation
the dti	The Department of Trade and Industry
THRIP	Technology and Human Resources for Industry Programme

Chapter 1: Introduction

1.1 Problem Definition

Despite an increasing global focus on the manufacturing sector (Giffi, Rodriguez, Gangula, Roth, & Hanley, 2016), the data presented by Statistics South Africa (Statistics South Africa, 2015a, 2015b) shows a contraction in the South African manufacturing sector. A continuous investment in research, development and innovation (RD&I) through a portfolio of policy instruments aimed at the public and private sector have yielded significant benefits for the top four most competitive nations in terms of manufacturing innovation (Giffi et al., 2016). Meuer, Rupietta and Backes-Gellner (2015) point out that this portfolio of policy instruments, also referred to as innovation policy mix, is unique to a country's technological positioning and is also sector dependent. The integration of the various policy instruments to achieve the collective goals of the various government departments raises the question of how innovation policy should be formulated so that the interplay between the various instruments complement each other.

This study aims to characterise and evaluate South Africa's innovation policy mix within the manufacturing sector of the economy, and compare this to other countries. This characterisation will then be applied to identify areas for improvement and hence increase the prospects for the sector in terms of its contribution to economic growth.

1.1.1 Innovation Policy Mix

The study of innovation policy mix has been receiving increasing attention in the literature particularly in respect of the interaction between different policy instruments in achieving their intended goals (Borrás & Edquist, 2013; Cunningham, Edler, Flanagan, & Laredo, 2013; Flanagan, Uyarra, & Laranja, 2011; Guerzoni & Raiteri, 2015; Lanahan & Feldman, 2015), which necessitates a holistic perspective in understanding, characterising and evaluating the performance of the policy mix. It is this interaction between policy instruments that also makes the formulation of an "optimal" policy mix difficult to determine (Cunningham et al., 2013).

Governments apply a mixture of public policy instruments to influence behaviour of the actors within a National System of Innovation. Public policy instruments may be defined as a set of techniques by which governmental authorities wield their influence in attempting to ensure

support and effect societal change (Borrás & Edquist, 2013). Innovation policy mix is implemented through such a set of policy instruments and the choice of policy instruments is a crucial decision in the formulation of an innovation policy (Borrás & Edquist, 2013).

1.1.2 Temporal Interaction of Policy Instruments

Flanagan, Uyarra and Laranja (2011) highlight that policy instruments cannot be evaluated in isolation from each other, as the interplay between the various policy instruments over time influence the extent to which goals are realised. Guerzoni and Raiteri (2015) provide empirical evidence that policy instruments have the highest impact when they interact with each other. Policy mix implies the trade-off between policy instruments as they impact the extent to which policy goals are realised.

1.1.3 Country and Sector Dependency of Policy Mix

Each country adopts a unique policy mix and can be characterised according to the specific policy mix that it adopts. Policy mix is also sector dependent and needs to be evaluated taking the sectoral patterns of innovation into account (Meuer et al., 2015).

According to Statistics South Africa (2015b) the manufacturing sector accounted for 13.3 per cent of the gross domestic product (GDP) in the fourth quarter of 2015. Despite this contribution to the GDP, there is a 0.8 per cent contraction of the manufacturing sector compared to the fourth quarter of 2014 (Statistics South Africa, 2015b). Innovation within the manufacturing sector is crucial for the development of the sector and policymakers need to create the conditions for growth (Becheikh, Landry, & Amara, 2006). Becheikh et al. (2006) recommend further research within the manufacturing sector to enable policymakers to understand the phenomenon driving growth in the sector.

Characterising South Africa's policy mix in the manufacturing sector and comparing it to other countries may provide insight into the approach towards innovation policy instruments that can be employed towards achieving appropriate results at a national level.

1.1.4 The Research Problem

This study addresses the problem of formulating innovation policy by characterising South Africa's current innovation policy mix. Particular attention will be given to the interaction between policy instruments and their effectiveness in achieving the goals of economic development. The characterisation is applied to explore future policy mix.

1.2 Research Objectives

The overall objective of this project is to characterise South Africa's innovation policy mix within a single sector of the economy with a particular focus on the manufacturing sector. This characterisation is to be used as a basis for comparison with other countries in order to determine the effectiveness of the set of policies that have been employed within the manufacturing sector of South Africa and to explore how a future policy mix for the South African manufacturing sector could be configured.

This may be broken down into the following discrete objectives:

1. Characterise and evaluate the current innovation policy mix.
    a. Identify and characterise the mix of policy instruments applied within the South African manufacturing sector.
    b. Characterise innovation policy mix applied within comparator countries' manufacturing sector for the purposes of comparison with South Africa.
2. Compare South Africa's innovation policy mix to that of two other countries.
    a. Canada, as an example of a developed country.
    b. India, as an example of a high growth developing country.
3. Evaluate the effectiveness of South Africa's innovation policy mix.
4. Determine how a future policy mix for South Africa could be configured in order to improve the outlook of the manufacturing sector.

1.3 Relevance of the Research

Innovation is a crucial driver of economic growth, and interplay between different innovation policy instruments needs to be understood to ensure that policy decisions effect the intended economic change. Much of the innovation policy research anchors on evolutionary economic theory and the insight of Joseph Schumpeter (1934) by starting with innovation as a critical dimension of economic change (Bajmócy & Gébert, 2014; Cooke, Uranga, & Etxebarria, 1997).

An understanding of the interactions between the collection of policy instruments that make up South Africa's innovation policy mix helps to influence economic change through effective policymaking.

1.4 Contribution to Theory

The policy mix from country to country differs and a review of the literature has revealed a gap in the characterisation of South Africa's policy mix. Such a characterisation of the policy mix creates a more substantive understanding of how the different policy instruments interact and stimulate or stifle economic development over a period of time. Such an understanding is important because it provides researchers with the ability to identify similarities and differences between the policy for different countries and sectors. Moreover, this understanding will facilitate the formulation of policy towards achieving the goals of economic development.

1.5 Conclusion

This chapter has presented an introduction to the research problem by identifying the problem, and has contextualised the problem in terms of the rationale for its selection, its relevance to business and its contribution to the theory. The remainder of this project is captured as follows:

Chapter 2: Literature Review – This chapter captures the state of the art by exploring the literature on innovation policy mix. The theory of the National System of Innovation (NSI) is established, before the concepts of policy instruments and their interaction within the NSI is discussed. The literature establishing the relationship and logic between policy and economic development is explored to integrate the gap between policy formulation and economic development. The key frameworks to be used in this study are discussed, and the chapter ends with some considerations for formulating a future innovation policy mix. The research questions are derived from the theory presented in this chapter.

Chapter 3: Research Questions – The research questions posed in this chapter form the basis of the research and aims to address the problem identified and discussed in the preceding chapters.

Chapter 4: Research Methodology and Design – This chapter will explain the proposed research methodology that will be applied towards answering the research questions posed.

Chapter 5: Results – The results of the research are presented in this chapter, with the data being clustered around each research question.

Chapter 6: Discussion – The results are discussed in terms of the research questions, and a link between the actual data and the literature is provided.

Chapter 7: Conclusion – The key findings of this research are summarised and presented with recommendations and suggestions for future research.

Chapter 2: Literature Review

2.1 Introduction

Governments apply a mix of policy instruments to achieve economic and social goals. It is therefore crucial to establish the logic behind economic and social development as a consequence of innovation.

The literature review begins by examining the influence that innovation has on economic development. National System of Innovation (NSI) theory is explained, and the use of policy instruments to achieve national innovation goals is discussed. Various policy trends are reviewed, and the application of policy in NSI management is explored. The theoretical foundations behind policy mix and their interaction over a period of time are investigated within the context of the South African manufacturing sector.

This link between NSI theory, policy theory and economic development is further investigated within the literature in order to establish a framework that can be applied to assess the effectiveness of policy.

This research aims to aid policy makers in formulating effective future policy. The literature review will therefore conclude with a view on the work that researchers have conducted on how future innovation policy mix should be formulated.

2.2 Link Between Innovation and Economic Growth

2.2.1 Economic Growth Theories

Schumpeter's work on establishing innovation as a driving force behind economic growth (J. A. Schumpeter & Opie, 1934) has been well established within the literature. Schumpeter (1935) links innovation to economic change by describing innovation as the "force" that drives the economy out of equilibrium through the insertion and adoption of new products and processes.

Wong et al. (2005) reflect on Schumpeter's early work describing the entrepreneur as the innovator who drives economic development, and that innovation is a source of economic growth. According to Schumpeter (1927), the innovator-entrepreneur stimulates investment in an economy by increasing production and correspondingly the circular flow of money. This disturbs the equilibrium and gives rise to an "economic boom". While the Schumpeterian

description couples entrepreneurship and innovation, Wong et al. (2005) expand this to the domain of large companies arguing that business creation activities are inherently linked to innovation activities in a firm.

Fagerberg and Srholec (2008) support Schumpeter's view that innovation drives economic growth by reviewing the work of other early economists reinforcing the argument that technological growth causes economic growth. Fagerberg and Srholec (2008) take this argument further by pointing out that the economic effects of innovation are dependent on the policy frameworks in place. Patanakul and Pinto's (2014) view of Schumpeter's work is consistent with the other researchers in that innovation is a dynamic force causing social, institutional and economic transformation.

Other more recent empirical studies have built on Schumpeter's descriptive work proving the relationship between innovation and economic growth (Wong et al., 2005). The "New Growth Theory" supporters argue that growth and development are driven by a focus on technology and innovation (Fagerberg & Srholec, 2008). New Growth Theory highlights that the benefit associated with new knowledge results in economic growth (Cortright, 2001). Molaei (2010) argues that knowledge plays a key role in economic growth, and saving and investment alone are not sufficient for economic growth. Unless they are accompanied by the generation of knowledge, a country's ability to create value from its natural resources will remain limited (Molaei, 2010).

Advocates of the Solow growth model recognise that economic growth is driven by increases in labour, capital and labour force productivity (Palley, 1996). Palley (1996) argues that the Solow model does not make a connection between savings, investment, and technological progress and shows analytically how technical growth impacts economic growth through the inclusion of the "technical growth function" in the growth equation.

2.2.2 Innovation as a Means Towards Economic Growth

Effectively developing and adopting new technologies is a means towards economic growth and there have been several studies that have empirically proved a correlation between innovation and economic development (Akcali & Sismanoglu, 2015). Akcali and Sismanoglu (2015) have compared research and development (R&D) spending to the gross domestic product (GDP) growth of various countries in order to "investigate the relationship between R&D expense as an indicator of innovation and economic growth in some developing and developed countries" (p.772). The empirical results of the study lead Akcali and Sismanoglu

(2015) to conclude that innovation is a key determinant of economic growth. This conclusion agrees with previous studies that have also proved a positive correlation between R&D spending and economic growth (Akcali & Sismanoglu, 2015). A shortcoming of the study is that economic development is defined purely in terms of GDP growth. Keola, Anderson and Hall (2015) question whether conventional indicators, such as GDP, alone are sufficient to measure economic growth and present evidence especially in developing countries.

Fagerberg and Srholec (2008) define a method to measure a country's innovation activity's contribution to economic growth. There are a large number of economic indicators that can be used to measure a country's economic state, and combining this information into a set of dimensions that can be applied to a country-by-country comparison is a key challenge faced by researchers (Fagerberg & Srholec, 2008). Other researchers have since applied this method of factor analysis to analyse a country's economic growth resulting from innovative capability (Carvalho, Carvalho, & Nunes, 2015; Jandhyala & Phene, 2015). The method of factor analysis is based on the principle that indicators referring to a single dimension are strongly correlated, leading to smaller number of composite variables (Fagerberg & Srholec, 2008). Fagerberg and Srholec (2008) have applied factor analysis to analyse 115 countries relating factor score to innovation activity.

Fagerberg and Srholec (2008) found a strong significant correlation between GDP per capita and the innovation system, making a well-developed innovation system a necessary condition for countries to prosper technologically. However, this is not a sufficient condition and good governance is also required to ensure economic success. The emerging conclusion from the work of Fagerberg and Srholec (2008) is that "Countries that succeed in developing and sustaining strong innovation capabilities and well-functioning systems of governance do well economically while those that fail tend to fall behind" (p. 1427). Patanakul and Pinto (2014) agree with this by concluding that innovation, when supported by governmental agencies is a fundamental driver of economic growth.

2.3 National Systems of Innovation

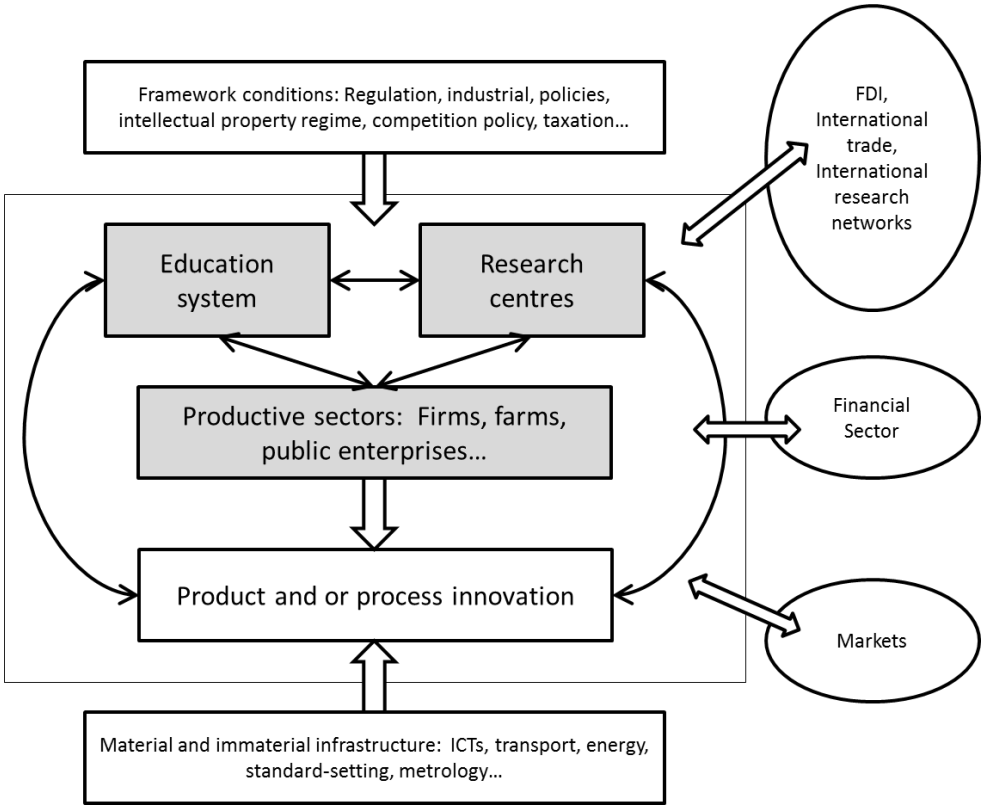
2.3.1 Defining the National System of Innovation

The White Paper on Science and Technology written by the Department of Arts, Culture, Science and Technology (1996, p. 20) defines the South African NSI as "a set of functioning institutions, organisations and policies which interact constructively in the pursuit of a common set of social and economic goals and objectives." The National System of

Innovation (NSI) is described by Manzini (2012) as a network of economic agents, together with the institutions and policies that influence their innovative behaviour and performance. Balzat (2004) defines the NSI as “a historically grown subsystem of the national economy in which various organizations and institutions interact with and influence one another in the carrying out of innovative activity” (p. 197).

The development of an approach towards the generation of profit from technology led to the development of the NSI concept (Fagerberg & Srholec, 2008). The NSI concept is not new and has roots as far back as 1841 when the Germany applied the concept to describe a collection of national institutions engaged in training, infrastructure development and transport (Johnson, Edquist, & Lundvall, 2003). More recently, according to Johnson et al. (2003), the concept focuses on the "systemic relationships between R&D efforts in firms, S&T-organizations, universities, and public policy" (p. 4). The fundamental elements of a NSI and their interrelationships are shown in Figure 1.

Figure 1 - A schematic diagram of a NSI (United Nations, 2011)



Manzini (2012) has analysed various definitions of the NSI and summarises that the key themes encapsulated by the NSI concept are: "a variety of institutions; interactions; and technological learning" (p. 2).

2.3.2 Modes of Innovation and Learning

Innovation is a process that occurs over time involving multiple institutions and is influenced by several factors (Edquist & Zabala-Iturriagagoitia, 2012). According to Edquist and Zabala-Iturriagagoitia (2012), organisations do not innovate in isolation, but interact with each other exchanging knowledge, information and resources. This is consistent with the key themes of Manzini (2012). The Organisation for Economic Co-operation and Development (OECD) (2008) agrees with this by stressing that it is necessary to understand the linkages between the actors involved in innovation in order to improve technology performance. These actors may be private firms, public firms or research institutes (Organisation for Economic Co-operation and Development (OECD), 2008).

Jensen, Johnson, Lorenz and Lundvall (2007) define two modes of innovation. The Science, Technology and Innovation (STI) mode is based on codified scientific and technical knowledge, and the doing, using and interacting (DUI) mode is based on informal experiential knowledge. The STI mode focuses on the formal R&D processes to produce codified research output. The DUI mode focuses on learning and competence building through the interactions within and between institutions within the NSI. Both modes exist in tension with each other, and Jensen et al. (2007) conclude that effectively combining the two modes is more likely to innovate new products and processes than relying primarily on one mode.

The two modes of innovation refer to four different types of knowledge, and therefore different channels through which the knowledge can be acquired. The four types of knowledge are know-what, know-why, know-how and know-who (Jensen et al., 2007). Know-what and know-why are typically acquired through formal teaching and R&D output. In contrast, know-how and know-who are acquired through more informal mechanisms such as apprenticeship relationships and social interaction (Jensen et al., 2007). This implies that innovation policy must accommodate learning and innovation through each of these channels in order to be effective.

Fitjar and Rodríguez-Pose (2013) validated the importance of combining the STI and DUI modes of innovation. Parrilli and Heras (2016) conducted a study confirming this finding, further emphasising importance of combining the STI and DUI modes of innovation. The study

went on to also prove that the STI mode has a greater impact on technological innovation, such as product and process innovation. The DUI mode has a greater impact on non-technological innovation, such as commercial and organisational impact (Parrilli & Heras, 2016). Parrilli and Heras (2016) went on to examine the geographical application of innovation modes and concluded that the context specific effects of cultural, social, institutional and technological positioning of different countries and regions justify the differentiated application of the modes of innovation. The NSI needs to enable these learning interactions and the effectiveness of the NSI may be defined by how well it incentivises and supports these learning interactions (United Nations, 2011).

This is an important outcome for policy making, as it shows firstly that innovation policy needs to combine the two modes of innovation through a mix of instruments that ensure an effective interaction between the modes. Secondly, innovation policy mix is unique and specific to a country, and the social and technological positioning of the country needs to be taken into account in the formulation policy. Policy makers may learn lessons from other countries, but ultimately must ensure that the various policy instruments are combined to achieve specific goals taking into account the unique positioning of the country.

Despite the need for a balanced combination of the two modes, there remains a bias towards the STI mode in policy making, especially within the technology intensive sectors (Jensen et al., 2007). At a policy level, this bias is evident in policy benchmarking variables such as publications, patents and other forms of codified R&D output (Jensen et al., 2007).

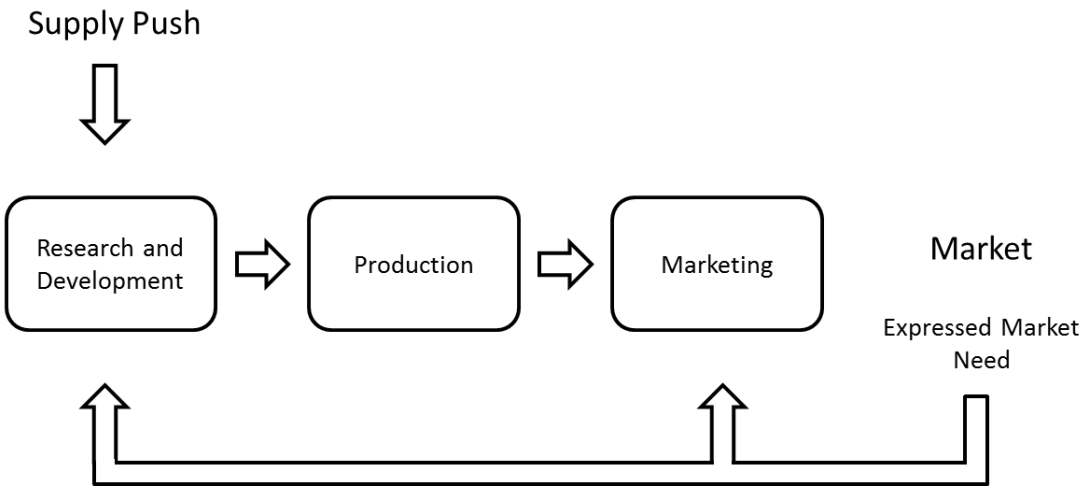
2.3.3 Supply and Demand in the NSI

Innovation processes and policies have been influenced by technology-push and demand-pull theories (Organisation for Economic Co-operation and Development (OECD), 2011). Supply-side theories support the push of technology and innovation into the market, while demand-side theories are based on the market's demand to pull innovation and technology to satisfy the market needs (Organisation for Economic Co-operation and Development (OECD), 2011). Supply-side innovation policies are therefore aimed at the start of the innovation value chain, while demand-side policies focus on reducing the barriers for innovation within the market. Supply-side policies include measures and incentives that directly support R&D and other codified forms of knowledge generation. Examples of supply-side policies include tax incentives for R&D investment by firms and support for education and training. In contrast,

demand-side policies include measures that stimulate a demand for innovation by directing innovation resources and capabilities towards meeting societal and market needs.

Despite the contrasting approaches that supply-side policy and demand-side policy take, neither of them can exist on their own (Organisation for Economic Co-operation and Development (OECD), 2011). Supply-side policies are supposed to encourage more radical innovation and demand-side policies are supposed to encourage more incremental innovation (Pattinson et al., 2015). The OECD (2011) recognise that neither can exist without the other, and both supply and demand-side policies need to be integrated to complement each other with a balance between supply-push and market-pull as depicted in Figure 2.

Figure 2 - Matching supply-push with demand-pull forces (Organisation for Economic Co-operation and Development (OECD), 2011)



Innovation policy is often the domain of the ministries of science and technologies, especially within developing countries, and their focus on science and technology based research results in a heavy emphasis on supply-side policy instruments (United Nations, 2011). These ministries often lack the political weight to formulate cross cutting policy measures that affect the linkages between scientific R&D, procurement, production and sales (United Nations, 2011).

Johnson et al. (2003) define two perspectives on the NSI that support the supply and demand theories. The narrow perspective on NSI theory focuses on the relationships between knowledge institutions with a focus on the high technology sectors, while the broader perspective sees innovation taking place beyond scientific R&D, stretching into the on-going

activities of procurement, production and sales (Johnson et al., 2003). Johnson et al. (2003) argue that the difference in perspective is due to the different nationality of the analyst. In smaller countries such as Denmark, as well as developing countries science based sectors form a smaller part of total employment, whereas in larger countries the aggregate economic growth is more directly connected to the expansion of the science based sectors (Johnson et al., 2003).

2.3.4 The implication of the NSI Concept

The widespread adoption of the NSI concept had far-reaching implications for national innovation policy making (Manzini, 2012) and the South African Government has therefore adopted the NSI as a framework for analysing and developing policy (Department of Arts Culture Science and Technology, 1996).

The NSI inherently takes into account the technological and economic position of the country. Ultimately the NSI is an innovation system that is built incrementally over many years, and depend on the geographical, political and technological positioning of the country (Fagerberg & Srholec, 2008).

Policy formulation based on the NSI approach is a complex undertaking that requires a variety of instruments to address the generation of knowledge (supply-side) and the use of that knowledge (demand-side) though a combination of the modes of innovation and learning. Such an amalgamation of policy instruments requires a diverse arsenal of policy instruments and highly coordinated management of these instruments (United Nations, 2011).

2.4 Innovation Policy

2.4.1 The Role of Policy in The Management of National Systems of Innovation

Borrás and Edquist (2013) argue that innovation policy is systemic, meaning that the impact of innovation policy is felt throughout the NSI. It is not just the instruments that make them systemic, but rather their interaction with each other based on the way they are combined to address the complex and multidimensional needs of problem areas (Borrás & Edquist, 2013). An understanding of the NSI and the interactions between actors within the NSI allows policymakers to diagnose problem areas that hinder technology development and innovation (Organisation for Economic Co-operation and Development (OECD), 2008).

Patanakul and Pinto (2014) describe two main drivers of innovation. The market based view states that the market provides the conditions that either enable or hinder the innovation process, while the resource based view states that firms need adequate resources to be innovative (Patanakul & Pinto, 2014). The OECD (2008) contends that new types of policy with a particular emphasis on improving the interaction between actors are required to address systemic failures. Substantial policy intervention has been directed towards addressing the market failures, or an underinvestment from the private enterprise in R&D (Organisation for Economic Co-operation and Development (OECD), 2008).

Despite the role that policy plays within the NSI, Patanakul and Pinto (2014) caution against the potential harmful effect that poorly conceived and poorly managed policy can have. Examples of such harmful effects are possible unfair competition and increased cost burden that firms incur to coordinate and manage innovation activities arising from policy (Patanakul & Pinto, 2014).

2.4.2 The National Advisory Council on Innovation

The South African government has recognised the complexity in innovation policy making within the NSI, and have legislated a National Advisory Council on Innovation (NACI) charged with carrying out studies in respect of the functioning of the NSI (Department of Arts Culture Science and Technology, 1996).

The objective of NACI is to advise government about the role of science, mathematics, innovation and technology in achieving national imperatives (Republic of South Africa, 1997). In order to achieve this NACI will, among other functions, advise on the coordination of science and technology policy with policies of other departments (Republic of South Africa, 1997).

2.4.3 Trends in Innovation Policy

Studies of the NSI has offered new alternatives and approaches to innovation policy (Organisation for Economic Co-operation and Development (OECD), 2008). There is an emphasis on the combination of the appropriate policy instruments, referred to as the policy mix, to achieve a set of goals (Organisation for Economic Co-operation and Development (OECD), 2008). Borrás and Edquist (2013) define innovation policy instrument mix as “the specific combination of innovation-related policy instruments which interact explicitly or implicitly in influencing innovation intensities” (p. 1520).

Borrás and Edquist (2013) define a "three-fold typology" of innovation policy instruments as consisting of regulatory instruments, financial and economic instruments, and soft instruments. According to Borrás and Edquist (2013), regulatory instruments apply legislation to regulate the interaction between agents within the NSI in order to achieve the goals that define the market conditions for innovative products and processes. Financial and economic instruments refer to a broad spectrum of instruments that provide financial incentives or disincentives for innovation activities (Borrás & Edquist, 2013). Soft instruments are non-coercive voluntary instruments that encourage transformative initiatives between actors (Borrás & Edquist, 2013). Borrás and Edquist (2013) refer to this typology as the "sticks, carrots and sermons" of public policy. While there are other classifications that exist, the three-fold typology is the most widely accepted in the literature and continues to be used in the practical context (Borrás & Edquist, 2013).

Supply-side policy instruments are aimed at promoting knowledge growth, and demand side policy instruments are aimed at growing market opportunities to increase the demand for innovation (Organisation for Economic Co- operation and Development (OECD), 2012).

Borrás and Edquist (2013) contend that science and technology policies focus too heavily on supply side instruments. Guerzoni and Raiteri (2015) discuss the concept of supply side instruments and demand side instruments. There has been substantial attention given to supply side policies such as tax credits and subsidies, but public procurement as an innovation policy instrument is a growing trend in the literature (Guerzoni & Raiteri, 2015). Guerzoni and Raiteri (2015) argue that previous studies on R&D subsidies overestimated their impact and suffer from an element of hidden treatment bias by not taking into account other policy options in the policy mix. Guerzoni and Raiteri (2015) replicate existing results and show that they do not hold when innovative public procurement is also taken into account.

There has been less attention focussed on the time aspects of policy analysis (Flanagan et al., 2011). In acknowledging context, it is also worth noting that the sequence of instruments is important (Flanagan et al., 2011). As an example, Flanagan et al. argue that introducing policy instrument A before policy instrument B may not necessarily provide the same result as policy instrument B before policy instrument A. The implication on this for policy making is that policy makers need to consider the temporal interaction of policy instruments with each other.

Fagerberg and Srholec (2008) explore how differences in capabilities between different countries cause some countries to excel and other to lag. The differences between country's

innovation positioning can be attributed to differences in "social capabilities" (Fagerberg & Srholec, 2008). Fagerberg and Srholec (2008) analyse the work of Alexander Gerschenkron where the performance of different countries was evaluated and the challenge of technological "catch up" was pointed out. It was concluded that countries had to develop policy instruments that were capable of gathering the necessary instruments to exploit the opportunities that were presented (Fagerberg & Srholec, 2008).

Robin and Schubert (2013) examine the impact of public-private partnership (PPP) on a firm's innovation activities by using survey data to benchmark the innovation activities of firms in France and Germany. According to the NIS approach, the interaction between institutions and industry is a fundamental driver of innovation activity. Robin and Schubert (2013) therefore conducted a study to examine the formal collaborations between firms and public research institutions. The study concluded that increasing the level of public-private collaboration is not likely to improve all forms of innovation intensity. Robin and Schubert (2013) do however point out that they are not suggesting that there is no economic importance in PPP. Robin and Schubert (2013) conclude that the level of collaboration between public and private institutions in France and Germany needs to be maintained, and innovation policy needs to support a limited supply-side approach.

This result contradicts the perspectives on NSI outlined by Johnson et al. (2003) who suggest that larger countries tend to favour the narrow perspective by growing the science and technology base through and emphasis on supply-side policy instruments. An explanation for the contradiction could be the different contexts of each study. Johnson et al. (Johnson et al., 2003) conducted their study on firms in Denmark, while Robin and Schubert (2013) based their study on firms in France and Germany.

Instruments are chosen to address a specific problem, and therefore exist within a context that is determined by the social, political and technological ideology of the government in that period of time (Borrás & Edquist, 2013). Therefore the choice of policy instruments is highly contextual and unique to a country.

2.5 South Africa's Innovation Policy Instruments

The White Paper on Science and Technology defines South Africa's innovation positioning and goals (Department of Arts Culture Science and Technology, 1996). Supporting the national growth and development strategy, and stimulation of the national system of innovation is viewed as central goals of the White Paper (Department of Arts Culture Science and

Technology, 1996). The White Paper acknowledges the social, economic, political and global context that the NSI functions within, and due consideration is given to the innovation and policy trends (Department of Arts Culture Science and Technology, 1996).

In formulating policy, the government may establish laws and regulations, allocate resources according to a set of priorities or initiate programmes related to innovation activities (Department of Arts Culture Science and Technology, 1996). This is aligned with the three-fold typology described by Borrás and Edquist (2013) where laws and regulations are the "sticks", allocated resources are the "carrots" and programmes related to innovation activities are the "sermons".

The regulatory instruments described by the White Paper (1996) include intellectual property laws, health, safety and environmental laws and regulations governing firms' and individuals' activities in the global marketplace. The primary financial and economic instruments that are included in the White Paper are innovation funds (Department of Arts Culture Science and Technology, 1996). Human resource development, public relationship building and capacity building form part of the soft instruments (Department of Arts Culture Science and Technology, 1996). Science and technology infrastructure is also a part of South Africa's policy mix, and provision is made within the policy framework for national facilities and expensive research equipment (Department of Arts Culture Science and Technology, 1996). Table 1 provides a list policy instruments employed by South Africa, with a brief description of the instrument and a characterisation to indicate the type of policy instrument.

Table 1 – List of South African policy Instruments (The Department of Trade and Industry (the dti), 2014)

Policy Instrument	Description
Automotive Incentive Scheme (AIS)	The AIS is an incentive designed to grow and develop the automotive sector through investment in new and/ or replacement models and components that will increase plant production volumes, sustain employment and/ or strengthen the automotive value chain.
Capital Projects Feasibility Programme (CPFP)	The CPFP is a cost-sharing grant that contributes to the cost of feasibility studies likely to lead to projects that will increase local exports and stimulate the market for South African capital goods and services .

Policy Instrument	Description
Clothing and Textile Competitiveness Improvement Programme (CTICIP)	The programme aims to build capacity among clothing and textile manufacturers and in other areas of the apparel value chain in South Africa to enable them to effectively supply their customers and compete on a global scale, encompassing issues of cost, qulaity, flexibility, reliability, adaptability, and capability to innovate.
Production Incentive	A sectoral incentive designed to assist industry in upgrading its processes, products and people.
Critical infrastructure Programme (CIP)	The CIP aims to leverage investment by supporting infrastructure that is deemed to be critical, thus lowering the cost of doing business. The South African Government is implementing the CIP to stimulate investment growth in line with the National Industrial Policy Framework (NIPF) and Industrial Policy Action Plan (IPAP).
Manufacturing Competitiveness Enhancement Programme (MCEP)	The MCEP aims to encourage enterprises to upgrade their production facilities, processes, products, upskill workers and to provide for the upgrading of sectors to maximise output and employment.
People-Carrier Automotive Incentive Scheme (P-AIS)	P-AIS is a sub-component of the Automotive Incentive Scheme (AIS) and provides a non-taxable cash grant of between 20% and 35% of the value of qualifying investment in productive assets with the objective of stimulating a growth path for the people carrier vehicles industry through investment in new and/or replacement models and components that will result in new or retention of employment and/or strengthen the automotive vehicles value chain.
Section 12I Tax Allowance Incentive (12I)	The 12I Tax Incentive is designed to support Greenfield investments (i.e. new industrial projects that utilise only new and unused manufacturing assets), as well as Brownfield investments (i.e. expansions or upgrades of existing industrial projects). The incentive offers support for both capital investment and training.
Support Programme for Industrial Innovation (SPII)	The SPII is designed to promote technology development in South Africa's industry, through the provision of financial assistance for the development of innovative products and/or processes. SPII is focussed specifically on the development phase, which begins at the conclusion of basic research and ends at the point when a pre-production prototype has been produced.
Black Business Supplier Development Programme (BBSDP)	The BBSDP is a cost-sharing grant offered to small black-owned enterprises to assist them to improve their competitiveness and sustainability. The programme provides grants to a maximum of R1 million (R800 000 for tools, machinery and equipment and R200 000 for business development and training interventions per eligible enterprise to improve their corporate governance, management, marketing, productivity and use of modern technology).

Policy Instrument	Description
Technology and Human Resources for Industry Programme (THRIP)	THRIP is a partnership programme funded by the Department of Trade and Industry (the dti) and managed by the National Research Foundation (NRF). On a cost-sharing basis with industry, THRIP supports science, engineering and technology research collaborations focused on addressing the technology needs of participating firms and encouraging the development and mobility of research personnel and students among participating organisations.
Small Enterprise Development Agency: Technology Programme	The seda Technology Programme (Stp) is a division of seda (Small Enterprise Development Agency) focusing on technology business incubation, quality & standards and technology transfer services & support to small enterprises.
Export Marketing and Investment Assistance (EMIA)	The EMIA scheme develops export markets for South African products and services and to recruit new foreign direct investment into the country.
Sector-Specific Assistance Scheme (SSAS)	The Sector Specific Assistance Scheme is a reimbursable cost-sharing incentive scheme whereby financial support is granted to organisations supporting the development of industry sectors and those contributing to the growth of South African exports.

2.6 Comparator Countries' Policy Mix

2.6.1 The logic of Comparative Analysis

Schneider and Ingram (1988) contend that it is possible to compare elements of policy designs, and that such comparisons allow the policy maker to improve policy design. Policies are similar from one nation to another in their programme specific characteristics, and comparative studies allow the policy maker to adapt and adopt components of a policy mix from various sources (Schneider & Ingram, 1988).

Salami and Soltanzadeh (2012) concur with the approach of comparative analysis for policy studies, and have conducted a comparative study of six countries to benchmark science, technology and innovation policy. The study motivates comparative analysis as a means to gain an understanding of the successful experiences of one country and apply it to another country. When applying comparative analysis, the institutional structure of the comparator countries need to be similar (Salami & Soltanzadeh, 2012; Schneider & Ingram, 1988). With this as a driving factor, the selection of comparator countries for this study is restricted to countries that derive their institutional structure from the NSI concept.

2.6.2 Choice of Comparator Countries

Canada and India have been chosen as comparator countries for this study. Canada was chosen as an example of a developed country, and India as an example of an emerging nation. Both of these countries employ the NSI concept, so the lessons learned from both of these countries may be applied to the South African context.

2.7 A Framework for Characterising Policy Mix

Policies can be characterised through their target groups, their desired outcomes and their funding mechanisms (Organisation for Economic Co- operation and Development (OECD), 2012). The OECD (2012) applied six policy categories in their Science, Technology and Industry Outlook survey to characterise policy mix of various countries. These categories are: population targeted versus generic instruments; technology targeted versus generic instruments; financial versus non-financial instruments; direct versus indirect financing instruments; competitive versus non-competitive instruments; and supply-side versus demand-side instruments.

2.7.1 Population Targeted versus Generic Instruments:

Population targeted instruments are aimed at specific sectors, or specific types of firms, especially SMEs or technology based firms (Organisation for Economic Co-operation and Development (OECD), 2014).

2.7.2 Sector or Technology-targeted versus Generic Instruments

Technology-targeted instruments favour specific types of sectors or technology (Organisation for Economic Co-operation and Development (OECD), 2014). Examples of sectors and technologies favoured by technology-targeted instruments are renewable energy, biotechnology and additive manufacturing.

2.7.3 Financial versus Non-financial Instruments

Non-financial instruments are instruments that do not involve the exchange of funds, but are based on other benefits. Examples of such benefits may include access to infrastructure, training, information or markets.

2.7.4 Direct versus Indirect Financing Instruments

Direct financing instruments include instruments such as loans, grants, repayable advances and innovation vouchers (Organisation for Economic Co-operation and Development (OECD), 2014). Indirect financial instruments include instruments such as tax incentives for innovation activity (Organisation for Economic Co-operation and Development (OECD), 2014).

2.7.5 Competitive versus Non-Competitive Instruments

Competitive instruments allocate funding based on the evaluation of competitive proposals against a set of criteria, with allocations based on the quality of the application and the available funding (Organisation for Economic Co-operation and Development (OECD), 2014).

2.7.6 Supply-side versus Demand-side Instruments

Supply side instruments focus on the generation of knowledge, while demand side instruments incentivise the growth of market opportunities to increase the demand for innovation (Organisation for Economic Co- operation and Development (OECD), 2012).

2.8 Assessing the Effectiveness of Policy Mix

Policy mix implies a focus on the interdependencies and interactions of different policies as different policy goals are realised (Flanagan et al., 2011). It is therefore important to define measures to review whether the conceived policy mix within the national context is achieving the intended outcomes.

The White Paper on Science and Technology defines the measure of success for the NSI as "a national system of innovation can only be judged as healthy if the knowledge, technologies, products and processes produced by the national system of science, engineering and technology have been converted into increased wealth, by industry and business, and into an improved quality of life for all members of society" (Department of Arts Culture Science and Technology, 1996, p. 19).

Flanagan et al. (2011) capture the crux of the policy argument is that the effects of single policies cannot be evaluated in isolation. This therefore precludes any static comparative analysis of the effectiveness of policy instruments (Flanagan et al., 2011). An analysis of the innovation system is an indicator of the development of a particular technology field (Reichardt, Negro, Rogge, & Hekkert, 2014).

Reichardt et al. (2014) propose that if policy mix is recognised as a constituent element of the innovation system, then an analysis of the innovation system itself can be undertaken and the impact of policy mix can be isolated. This approach towards policy analysis may provide policy makers the necessary insight towards policy formulation (Reichardt et al., 2014).

2.9 Formulation of Policy Mix for the Future

Choice of policy instruments must link diagnosis of problem to policy instruments in order to mitigate problems (Borrás & Edquist, 2013). The implication of this is that policymakers need insight and understanding into the impact of the current policy instruments, before being able to formulate new policy. However there will always be an uncertainty about which aspect of the policy instrument is responsible for an observed effect (Flanagan et al., 2011). Furthermore, Flanagan et al. (2011) argue that policy instruments are also not stable over time, and have the capacity to change the context within which future policy processes will occur. The interpretive flexibility of policy instruments makes context critical, especially as many policy instruments are intangible (Flanagan et al., 2011). The implication of this is that what an instrument may achieve in one context may vary in another.

Flanagan et al. (2011) contend that historical policy constrains the options available to the policymaker. This forces policy makers to add policy to the mix and this gradual growth of policy instruments may further restrict the available options with the unintended outcome of possibly creating new problems (Flanagan et al., 2011). Policy processes take time to play out, and there is an aspect of policy learning that inevitably plays out, making the policymaking process evolutionary in nature (Flanagan et al., 2011).

Borrás and Edquist (2013) argue that policy formulation ultimately revolves around a choice of instruments and this choice revolves around three dimensions. First a primary selection of the most suitable instruments available is made (Borrás & Edquist, 2013). Second, the instruments are customised for the context that they are intended to operate within and finally the actual mix of instruments are designed so that they can complement each other (Borrás & Edquist, 2013). Borrás and Edquist (2013) argue that adapting the instrument to address the problem it is intended for is a crucial dimension of this, and an especially important step is considering the administrative structures and their capacity to implement the instrument.

Therefore instrument policy choices are there to influence innovation processes towards achieving political goals (Borrás & Edquist, 2013). There are however hazards in policymaking, and Fagerberg and Srholec (2008) caution against merely mimicking the policy and institutional

arrangements of the other "Western democracies". This is not a recipe for success and Fagerberg and Srholec (2008) have confirmed the findings of other researchers in the subject that political and technological context of the country is a crucial element in determining the success of policy. Flanagan et al. (2011) also caution that policy mix is not merely a term synonymous with an aggregation of expanding policy instruments. It also implies a value judgement on what constitute the boundaries of innovation policy (Flanagan et al., 2011). In a multi-actor system, the complexity of governance and administration of innovation policy is difficult, if not impossible (Flanagan et al., 2011).

2.10 Conclusion

The review of the literature on the topic of innovation policy mix can be split into three parts, Part A, Part B and Part C. Part A of this literature review defines the need for this study by exploring the link between innovation and economic growth. The early work of Joseph Schumpeter (1934; 1927, 1947; 1935) establishing innovation as driving force behind economic growth was used as a basis for this argument. Various other researchers have since applied Schumpeter's theories in linking innovation and economic growth, and showing that effective government policy is required to foster the innovation that drives this growth (Patanakul & Pinto, 2014).

Part B explores the theoretical foundations for the study against this backdrop of innovation as driver of economic growth. The concepts of NSI and its implications are discussed. Innovation policy is intended to nurture an effective NSI. The generation and application of knowledge within the NSI are discussed using the constructs of STI and DUI. Innovation policy is discussed and the concepts of supply-side policies and demand-side policy are explored. This study evaluates South Africa's Innovation policy mix, and it was therefore necessary to explore South Africa's innovation policy instruments within the literature. Discovering what instruments constitute South Africa's policy mix leads towards defining the first research question dealing with characterising South Africa's policy mix.

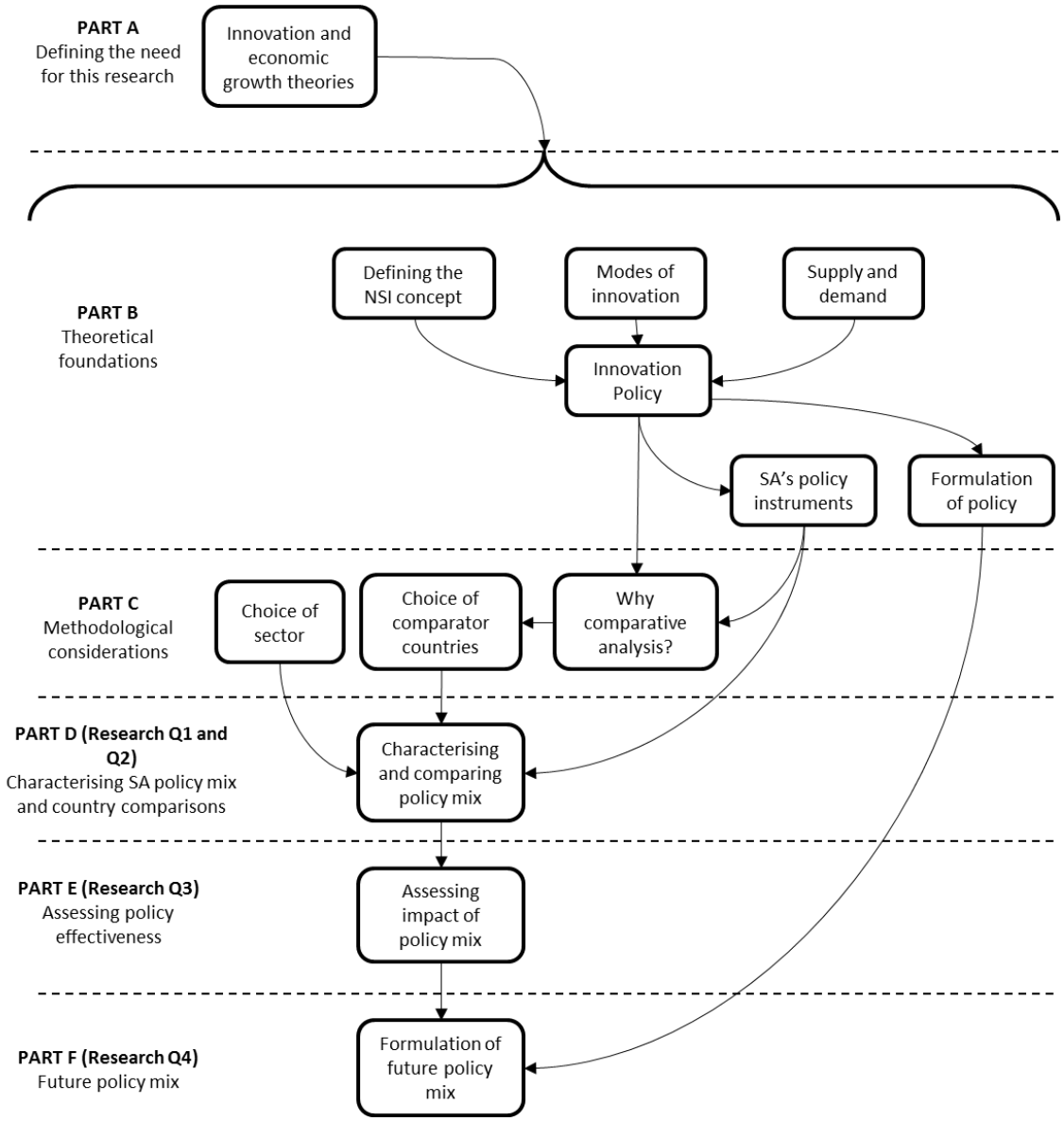
Part C uncovers some of the methodological considerations for this study that emerge from the literature. The logic behind comparative analysis for this study is discussed and the choice of comparator countries is also evaluated, leading towards defining the second research question dealing with comparative analysis.

In order to evaluate the configuration of an innovation policy mix, it is essential to have a framework that can categorise the various policy instruments. The OECD framework is

discussed and this framework is used to characterise, compare and analyse the innovation policy mix of South Africa and the comparator countries.

Figure 3 shows the relationships between the different concepts in the literature review, and how they relate to the research questions (Part D, Part E and Part F) that are presented in Chapter 3.

Figure 3 - Graphical summary of the literature review



Chapter 3: Research Questions

3.1 Introduction

The objective of this project is to characterise South Africa's innovation policy mix within a single sector of the economy with a particular focus on the manufacturing sector. This characterisation is to be used as a basis for comparison with other countries in order to determine the effectiveness of the set of policies that have been employed within the manufacturing sector of South Africa and explore what future policy mix for the South African manufacturing sector should look like. This study will consider two comparator countries. A high growth developing country and a developed country will be used as a basis to learn from the comparator countries. India, as an example of a high growth developing country, and Canada, as an example of a developed country, will be used in this study.

The first research question has been structured to characterise the current policy mix within the South African manufacturing sector and also to characterise the policy mix in each of the comparator countries that form part of this study.

The contextual and country specific nature of innovation policy was explored in the previous chapter through the literature. Research question 2 will examine this by comparing the innovation policy mix in the South African manufacturing sector with the policy mix for the manufacturing sectors of other countries with the intent of learning from the comparator countries.

The ultimate goal of policy is to effect social and economic change. It is therefore necessary to evaluate whether the policy mix achieves this goal. Research question 3 looks at how effective South Africa's policy mix has been for the manufacturing sector.

The contribution of this research is that an improved understanding of the innovation policy mix will facilitate the formulation of policy. Research question explores the implications of innovation policy mix within the South African manufacturing sector for future policy makers.

The research questions are captured below.

3.2 Research Question 1 – Characterising the Policy Mix

3.2.1 Research Question 1a – South African Innovation Policy Mix

What is the current innovation policy mix for the South African manufacturing sector?

3.2.2 Research Question 1b – Indian Innovation Policy Mix

What is the current innovation policy mix for the Indian manufacturing sector?

3.2.3 Research Question 1c – Canadian Innovation Policy Mix

What is the current innovation policy mix for the Canadian manufacturing sector?

3.3 Research Question 2 – Country Comparisons

How does South Africa's innovation policy mix within the manufacturing sector compare with the policy mix for the manufacturing sector of other comparator countries?

3.4 Research Question 3 – Policy Effectiveness

How effective has South Africa's approach been in addressing economic growth within the manufacturing sector?

3.5 Research Question 4 – Future Innovation Policy Mix

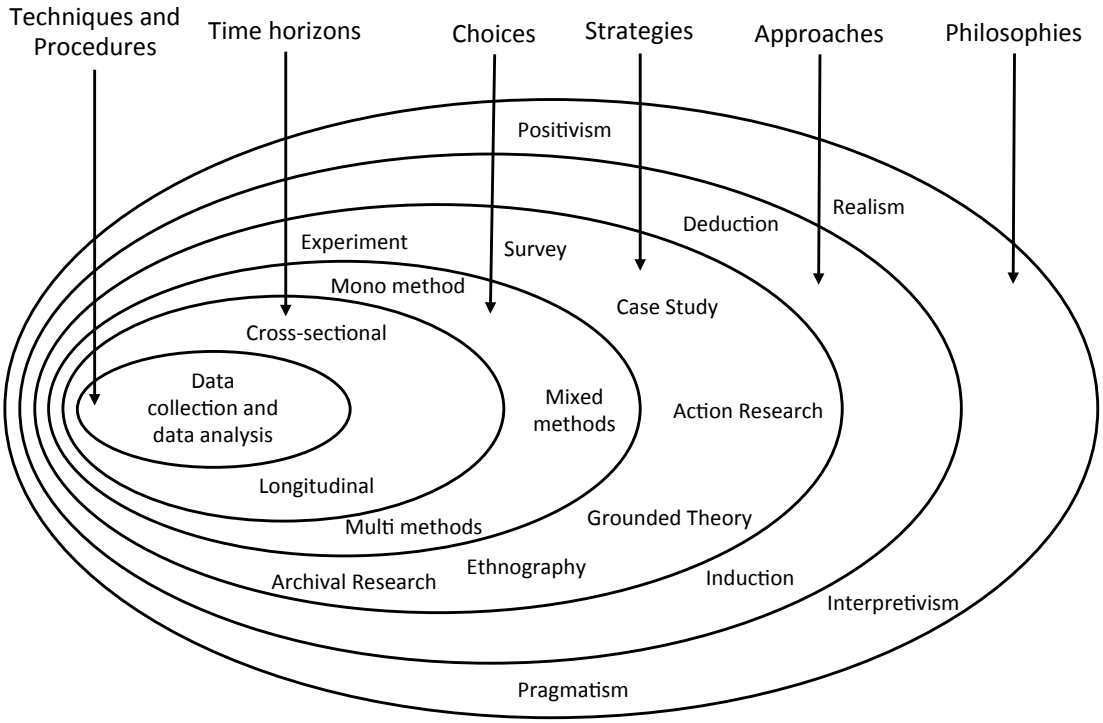
How should a future innovation policy mix for South Africa be configured in order to improve the outlook for the manufacturing sector?

Chapter 4: Research Methodology and Design

4.1 Introduction

There are four key objectives to this study described in Section 1.2 and these objectives are addressed through the research questions posed in Chapter 3. This chapter presents the proposed research design for this study and is based on the literature review presented in Chapter 2. Saunders and Lewis (Saunders & Lewis, 2012) introduce the research onion depicted in Figure 4 as a metaphor to describe the layers of the research process. The research design described in this chapter applies this layered concept of Figure 4 to first examine the research philosophy, approach, strategy and choice of method, and time horizons before describing the data collection and analysis procedures.

Figure 4 - The research onion (Saunders & Lewis, 2012, p. 103)



4.2 Research design

Research design involves the translation of research questions into research variables, deciding on data collection methods, and choosing appropriate analysis methods to ensure that the research questions are answered (Page & Meyer, 1999).

4.2.1 Research Philosophy

Research philosophy relates to the "development of knowledge and the nature of that knowledge in relation to research" (Saunders & Lewis, 2012). The research philosophy that is adopted therefore contains a set of assumptions that are key to how a research strategy is chosen (Saunders & Lewis, 2012). According to Saunders and Lewis (2012) the main strands of research philosophy are positivism, realism, interpretivism and pragmatism. Positivism applies the scientific method to quantify causal relationships between variables (Saunders & Lewis, 2012). Realism is about understanding and describing structures and relations that are not immediately apparent (Saunders & Lewis, 2012). Interpretivism is relates to the understanding of social phenomena (Saunders & Lewis, 2012). Pragmatism suggests that the most important determinants of research philosophy are the research objectives and questions (Saunders & Lewis, 2012). Saunders and Lewis (Saunders & Lewis, 2012) therefore argue that mixing methods within one study are both possible and highly appropriate.

This research contains multiple objectives of characterising policy mix, comparing policy mix between countries, assessing effectiveness and ultimately exploring a future policy mix configuration. The philosophy adopted in this research is therefore positivist.

4.2.2 Research Approach

Saunders and Lewis (Saunders & Lewis, 2012) describe deduction as an approach to test a proposition, and induction as an approach to develop a theory. Page and Meyer (1999, p. 22) define the phenomenological approach as an approach that uncover key issues during the course of the study. Description is central to the phenomenological approach, and findings are usually expressed in qualitative terms (Page & Meyer, 1999, p. 22).

The objective of this study is to characterise and understand the phenomena that underpin the innovation policy mix in the South African manufacturing sector. This study therefore applied the mixed method approach of deduction through quantitative secondary data, supplemented with the phenomenological approach based on qualitative primary data.

4.2.3 Research Strategies And Methods

The survey method is a research strategy that involves the structured collection of data (Saunders & Lewis, 2012). The data gained from the survey method is useful to answer descriptive questions about a phenomenon, while the case study strategy is applied to uncover why the phenomenon occurs (Saunders & Lewis, 2012).

METHOD	(1) Form of Research Question	(2) Requires Control of Behavioural Events?	(3) Focuses on Contemporary Events?
Experiment	how, why?	Yes	Yes
Survey	who, what, where, how many, how much?	No	Yes
Archival Analysis	Who, what, where, how many, how much?	No	Yes/No
History	how, why?	No	No
Case Study	how, why?	No	Yes

Table 2 - Relevant situations for different research methods (Yin, 2009, p. 8)

Yin (2009) provides a framework for the choice of research method shown in Table 2. This framework is applied to each of the research questions in this study to decide on the choice of method to be applied.

Research question 1 examines "what" the current innovation policy mix is. The question does not require any control of behavioural event and focuses on contemporary events, making archival analysis methods appropriate.

Research question 2 interrogates "how" South Africa's policy mix compares to other countries. The question does not require any control of behavioural event and focuses on contemporary events, making case study methods appropriate.

Research question 3 investigates "how" effective South Africa's policy mix has been. The question does not require any control of behavioural event and focuses on contemporary events, making case study methods appropriate.

Research Question 4 examines "how" future policy mix should be configured. The question does not require any control of behavioural event and focuses on contemporary events, making case study methods appropriate.

4.2.4 Time Horizons

Time horizon refers to the time line that the research is to be conducted in, and identifies whether the research is a static snapshot in time or whether the research dynamically tracks events over time (Page & Meyer, 1999). A static snapshot in time is referred to as a cross-sectional study (Saunders & Lewis, 2012). A study of a topic over a length of time is referred to as a longitudinal study (Saunders & Lewis, 2012).

Research question 1 and research question 2 of this study are cross-sectional and characterise the innovation policy mix a specific point in time. Research question 3 and research question 4 introduce a longitudinal element to this research by evaluating how effective the innovation policy mix has been over a period of time, and by projecting how future innovation policy mix should be configured.

4.3 Population

Saunders and Lewis (2012) describe the population as "the complete set of group members" (p132). For this study, the population includes all countries that apply the National System of Innovation (NSI) concept.

4.4 Unit of Analysis

The unit of analysis is firms within the manufacturing sector of the country.

4.5 Sampling Method and Size

The sampling method for this study is non-probability purposive sampling. Purposive sampling applies judgement to select a small sample in order to collect qualitative data based on a range of reasons (Saunders & Lewis, 2012). Such a sample consists of respondents who, in the judgement of the researcher, will provide the necessary information (Page & Meyer, 1999), meaning that some of the population will have a chance of being selected and some will not (Saunders & Lewis, 2012).

4.5.1 Research Question 1 and Research Question 2

Research question 1 and question 2 characterise and compare the innovation policy mix of South Africa with two comparator countries. Judgement is used to select the countries as the basis for comparison in order to answer the research questions. For this study, the comparator countries that were chosen are India and Canada. India has been chosen as an example of an emerging country. Canada has been chosen as an example of a developed country. Both of these countries apply the NSI concept and have similar institutional structures to South Africa with regard to the NSI.

4.5.2 Research Question 3 and Research Question 4

Research question 3 and question 4 evaluate the effectiveness of policy mix, and propose how future policy mix should be configured. In order to understand the effectiveness of national policy, it is necessary to evaluate the impact that policy has had on firms operating within that country and within the sector chosen for this study. Interviews were used to achieve this and the participants were chosen based on a set of criteria.

The first criterion was that the participants represented firms that were operating within the manufacturing sector of the South African economy. This was not restricted to any specific sub-sector within the manufacturing sector and included, for example, automotive manufacturing and production, defence manufacturing and production and electronics manufacturing.

The second criterion used for selection of interview participants was the amount of experience within their company and their seniority within the company. In this study, participants were chosen who had either worked at least five years in the company. An exception was made for participants who were either founders of an enterprise that had been in existence for less than five years, or for participants who were CEOs of a company. CEOs are often employed on contracts with five-year terms. The reason for this criterion was two-fold. Firstly the impact of innovation policy is usually seen over a period of time, and it was important for the participants to have been with the company for a long enough period of time to provide meaningful feedback on the topic. Secondly, the level of seniority provided an element of internal validity. The premise is that senior management should be able to better evaluate the overall impact of policy on the performance of the firm.

Saunders and Lewis (2012) describe several varieties of purposive sampling, and define a heterogeneous sample as having sufficiently diverse characteristics to provide maximum variation in the collected data. The underlying premise is that patterns that emerge from such a sample will represent the key themes (Saunders & Lewis, 2012). Participants were therefore targeted from different sub-sectors of manufacturing, and also from firms that spanned a range from new emerging small enterprises to large automotive manufacturers.

Eleven interviews were conducted with participants meeting the above criteria.

4.6 Measurement Instrument

4.6.1 Research Question 1 and Research Question 2

Research question 1 and research question 2 made use of quantitative publicly available secondary data to characterise the policy mix and draw comparisons. National spending on the various policy instruments identified in Table 1 in Section 2.5 was used to characterise South Africa's innovation policy mix. The policy mix of the comparator countries was also based on publicly available national spending figures.

4.6.2 Research Question 3 and Research Question 4

Research question 3 and research question 4 made use of semi-structured interviews to uncover how effective the policy mix was, and to explore how future policy mix should be configured. Semi-structured interviews is a data collection method where the interviewer explores a set of themes using some predetermined questions, but may vary the order or omit some questions (Saunders & Lewis, 2012).

The interview guide was designed to uncover the following information:

1. Demographic information:
    a. Sector that the company falls within
    b. Experience and level of seniority of the participant within the company
2. Whether the company used any of the innovation policy instruments and which ones were used;
3. How effective these instruments were;
4. What, in the participants view, should change to make innovation policy more effective.

Before conducting any interviews with the selected participants, the interview was pilot tested. Saunders and Lewis (2012) recommends such a pilot test to ensure that the questions are likely to be understood, to uncover potential problems with questions, and to provide an estimate of the duration of the interview. The interview questioned the participants' experience of the various policy instruments and its impact on the firm.

The pilot test showed that it was not sufficient for the interviewer to simply mention a sample of policy instruments, but it helped the participant to answer the questions if they were presented with a list of instruments and a short description of each instrument in question. The interview guide was updated to include a listing of policy instruments that the South African government applies. This list was based on Table 1 and was presented to the participants allowing the participants to refresh their memory and engage in a discussion around the relevant instruments.

The pilot test also showed that it was necessary to clarify what the interviewer meant by using the word "impact" and "effectiveness". Both of these words were defined in the interview guide and were explained to the participants during the interview.

The final interview guide that was used to conduct the interviews is shown in Appendix A.

4.7 Data Gathering Process

Research question 1 and research question 2 were answered using secondary quantitative data of national spending through innovation policy instruments as the basis for characterisation of the policy mix.

Research question 3 and research question 4 were addressed through gathering primary qualitative data from interviews.

4.7.1 Research Question 1 and Research Question 2: Quantitative Data Gathering

The data used for this study was obtained from an evaluation of national spending on the respective policy instruments, as well as World Bank data obtained from innovation policy databases (World Bank, 2015).

4.7.2 Research Question 3 and Research Question 4: Qualitative Data Gathering

Semi-structured interviews were used to gather the qualitative data required to address research question 3 and question 4. A set of pre-formulated questions were used as a guide,

although the interview took the form of a conversation that explored the various aspects of innovation policy and its impact on the participant's company.

Semi-structured interviews, also referred to as qualitative interviews, require some preparation (Saunders & Lewis, 2012). Saunders and Lewis (2012) suggest setting up an interview guide and a consent form for the study as preparatory steps. A consent form was prepared for this study, giving the participant a brief background of the research topic, and also requesting permission for an interview with the participant. The consent form is shown in Appendix B. All of the participants of this study have signed the consent form to be interviewed.

With the permission of the participants, the interviews were digitally recorded and later transcribed. Participants gave permission to do this by signing a form giving consent to record the audio of the interview. This consent form appears in Appendix C. All of the participants, with the exception of one gave consent to record the interview. Participant P7 did not consent to making an audio recording of the interview. In this case, notes were taken during the interview and then later typed into a document. These notes were sent back to the participant to confirm that the interview had been captured as intended.

All interview transcripts were imported into a computer-aided qualitative data analysis software (CAQDAS) tool for subsequent analysis. Atlas.ti was used as the tool to perform qualitative data analysis.

4.8 Analysis Approach

4.8.1 Research Question 1 and Research Question 2: Quantitative Data Analysis

Research question 1 and research question 2 was analysed quantitatively by plotting the actual spending on each policy instrument against each other. The categories on the OECD framework described in Section 2.7 were used as axis labels.

4.8.2 Research Question 3 and Research Question 4: Qualitative Data Analysis

Research question 3 and research question 4 was analysed qualitatively by coding transcripts of interviews into a CAQDAS tool for qualitative analysis in order to identify the various themes that emerged from the interviews.

4.9 Reliability and Validity

Validity refers to the extent that the data collection methods measure what was intended, and that the research finding are actually what they claim to be (Saunders & Lewis, 2012, p. 127). Reliability relates to the consistency in the data collection methods and analysis procedures to reproduce the findings of the study (Saunders & Lewis, 2012, p. 128).

Research question 1 and research 2 achieve internal validity by using secondary quantitative data collection methods. This research does not attempt to provide answers that can be generalised across the population. It is specific to the particular research setting and therefore external validity is low.

Research question 3 and research question 4 apply the principle of triangulation to achieve internal validity by interviewing industry participants from vastly different parts of the manufacturing sector, working with a very diverse set of policy instruments.

4.10 Limitations

The sampling technique is non-probability, and so conclusions are not generalizable to other sectors of the economy or to other countries. However, the nature of this study is highly contextual, and the findings are not intended to be generalised across the population. The conclusions apply to the South African Manufacturing sector.

Chapter 5: Results

5.1 Introduction

The methodology for data gathering and data analysis was outlined in the previous chapter. This chapter presents the results of this data gathering process within the context of the research questions posed in Chapter 3. The research methodology for this study called for mixed methods, meaning that quantitative and qualitative data was used to answer the research questions that were posed.

The chapter starts with by presenting an overview of the quantitative and the qualitative data, before presenting the results that answer each research question. An analysis of the results is discussed in Chapter 6.

5.2 Description of Quantitative Data

5.2.1 South Africa's Innovation Policy Mix

The South African innovation policy mix was characterised by examining the South African national spending on the incentive schemes that the South African government offers to the manufacturing sector. Many of the schemes are cross cutting, and the manufacturing sector may benefit from incentives that are not solely aimed at the sector alone. It was not practical or possible within the scope of this research project to isolate the spending that was incurred directly to the manufacturing industry within the time constraints of this research project. The Black Business Supplier Development Programme is an example of such a cross cutting incentive. The spending on these schemes has therefore been included in total, regardless of the actual primary beneficiary. Some incentives are however clearly not applicable to the manufacturing sector, and have been excluded from this study. The Film and Television Incentive is an example of such an incentive that has no impact on the manufacturing sector.

Spending was also examined in terms of the government department that incurred the expenditure. The three main government departments considered for this study are the Department of Trade and Industry (the dti), the Department of Science and Technology (DST) and the Department of Higher Education and Training (DHET). In the case of DHET, only R&D output was considered for this study. R&D output can be regarded as contributing directly towards the manufacturing sector, as a large portion of R&D output is intended to create the seed for the development of new products and services. Teaching output and institutional

factors were therefore not considered. The challenge of isolating and accurately attributing the actual expenditure sector by sector is beyond the scope of this research project and is acknowledged as a weakness in the methodology. Table 3 shows a listing of the policy instruments and incentives that were considered as part of this study along with their associated government department.

Table 3 – Innovation policy instruments considered in this study

Incentive Scheme or Support	Government Department responsible for instrument
Automotive Investment Scheme (AIS)	the dti
Capital Projects Feasibility Programme (CPFP) (Estimated)	the dti
Clothing and Textile Competitiveness Improvement Programme (CTCIP)	the dti
Critical Infrastructure Programme (CIP) (Estimated)	the dti
Manufacturing Competitiveness Enhancement Programme (MCEP)	the dti
Section 12I Tax Allowance Incentive (12I)	the dti
Support Programme for Industrial Innovation (SPII) and Other	the dti
Black Business Supplier Development Programme (BBSDP)	the dti
Co-operative Incentive Scheme (CIS)	the dti
Technology and Human Resources for Industry Programme (THRIP)	the dti
Incubation Support Programme (ISP) (Estimated)	the dti
Export Marketing and Investment Assistance (EMIA)	the dti
Special Economic Zones and Industrial Development Zones	the dti
Sector-Specific Assistance Scheme (SSAS)	the dti
Higher Education Institutions (Innovation)	the dti
Small Enterprise Development Agency :Technology Programme (Tech Transfer)	the dti
Small Enterprise Development Agency	the dti

Incentive Scheme or Support	Government Department responsible for instrument
Research, Development and Innovation	DST
Internal Resources & Cooperation	DST
Human Capital and Knowledge Systems	DST
Socio-Economic Partnerships	DST
Research outputs	DHET
Earmarked Funds	DHET

5.2.2 Comparator Countries' Innovation Policy mix

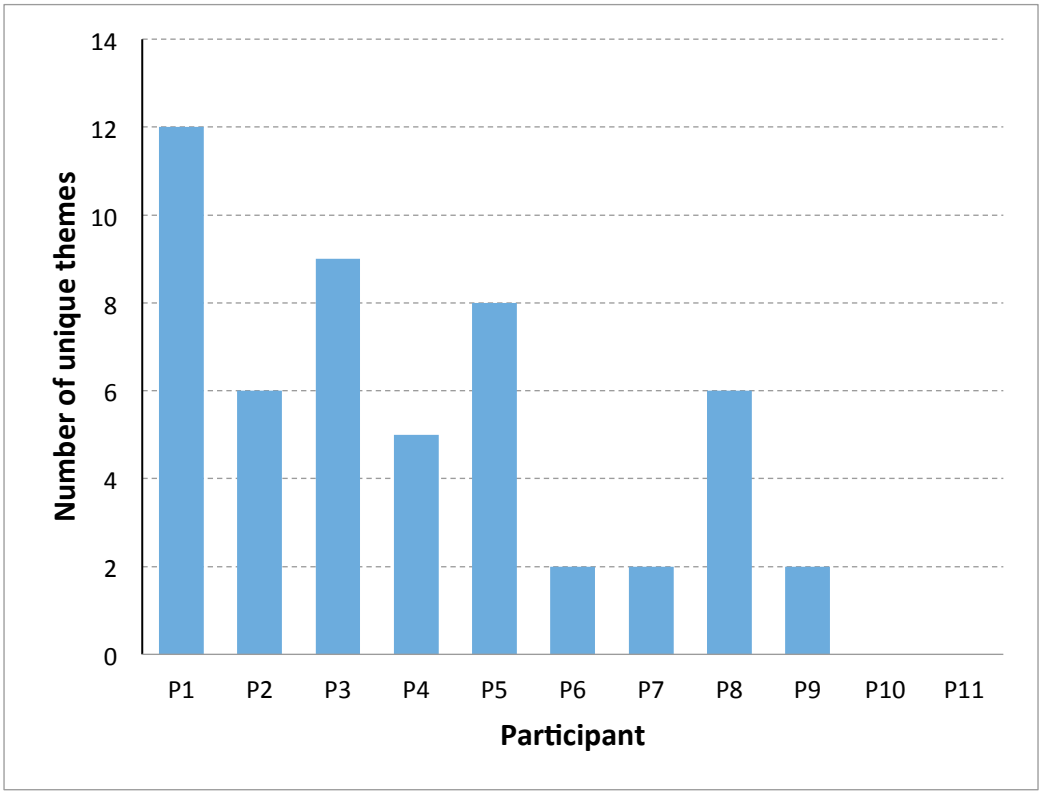
India and Canada were used as comparator countries for this study. India is regarded as a fast growing emerging economy, and Canada is considered a large economy with a well developed STI system (Organisation for Economic Co-operation and Development (OECD), 2014). Characterising the innovation policy mix of India and Canada is done for the purpose of comparison with South Africa. It was therefore not necessary to examine each policy instrument in detail as was done for the South African innovation policy instruments. The relative balance of the innovation policy mix for the comparator countries was more important than knowing the absolute national expenditure on expenditure. The OECD categorisation framework described in Section 2.7 was used to characterise the innovation policy mix of the comparator countries.

5.3 Description of Qualitative Data

5.3.1 Number of Interviews and Data Saturation

Eleven interviews were conducted for this study. Fifteen interviews were targeted, but by the end of the tenth interview no new concepts were emerging from the interviews. Figure 5 illustrates this by showing the number of new codes that emerged for each participant, P1 to P11, as the interviews progressed. Fusch and Ness (2015) highlight that no new codes mean that no new themes are emerging, and therefore it is likely that data saturation has been reached. It was therefore decided that no more interviews were necessary, and no further interviews were sought.

Figure 5 - Data saturation



5.3.2 Description of Participants

This study did not record the names of the participants, or the name of the company that they worked in. The focus of the interview was to uncover how policy impacted the sector, and the participants were treated as a proxy to gather that information from their companies within the manufacturing sector. It was therefore important to record the sector that the participants' companies served, rather than the participants' personal details. Participants' names were replaced with pseudonyms in the form of alphanumeric codes in order to conceal identities and ensure confidentiality.

However, it was important to note that the participants had the necessary expertise and experience to contribute to have observed the effects that this study was evaluating. For this reason, the position and experience levels of the participants were recorded.

Table 4 shows the description of each participant in terms of the sector that their company operates in, the participants' position and the participants' experience levels. It is important to note that the study aims at improving the outlook for the manufacturing sector as a whole,

so the interview subjects were chosen from any of the sub-sectors that perform manufacturing functions within the manufacturing sector.

Table 4 - Overview of participants' profiles

Participant	Sector	Position	Experience in that organisation
P1	Manufacturing	Co-Founder and CEO	A start-up, so less than one year
P2	Defence, Aerospace Manufacturing	Executive manager	Just under 30 years
P3	Automotive	Executive manager for Production	Just under 5 years
P4	Defence, Manufacturing	Programme Manager	14 years
P5	Defence Manufacturing	Engineering Manager	Just over 5 years.
P6	Engineering Defence	Head of a business unit	9 Years
P7	Defence Manufacturing and production	Engineering Manager	7 years
P8	Strictly ICT sector, so the business is in the ICT sector, although we have the electronics manufacturing business	CEO	21 years
P9	Manufacturing	Founder and co-owner	15 years
P10	Defence Manufacturing and development	CEO	9 Months
P11	Manufacturing for the mining industry	Chief operations officer	14 years

5.4 Research Question 1 – Characterising the Policy Mix

Research question 1 characterises how policy mix is configured within the manufacturing sector, first for South Africa, and then for each of the comparator countries.

5.4.1 Research Question 1a – South African Innovation Policy Mix

The first objective of this study is to identify and characterise the mix of policy instruments that the South African government applies to achieve growth objectives within the manufacturing sector. These instruments have been identified and presented in Table 3. The OECD categorisation framework presented in Section 2.7 is used to characterise South Africa's innovation policy mix. The allocation of categories is based on the logic that public innovation expenditure is directed towards improving the innovation capacity and capability of firms within the manufacturing sector. The categorisation of policy instruments according to this framework is shown in Table 5.

Table 5 – Characterisation of policy instruments

Incentive Scheme or Support	Population vs Generic	Sector or Technology vs Generic	Financial vs Non-Financial	Direct vs Indirect	Competitive vs Non Competitive	Supply-Side vs Demand-Side
Automotive Investment Scheme (AIS)	Generic	Sector	Financial	Indirect	Non Competitive	Demand-Side
Capital Projects Feasibility Programme (CPFP) (Estimated)	Generic	Generic	Financial	Direct	Non Competitive	Supply-Side
Clothing and Textile Competitiveness Improvement Programme (CTCIP)	Generic	Sector	Financial	Direct	Non Competitive	Supply-Side
Critical Infrastructure Programme (CIP) (Estimated)	Population	Sector	Financial	Direct	Non Competitive	Supply-Side
Manufacturing Competitiveness Enhancement Programme (MCEP)	Generic	Generic	Financial	Direct	Non Competitive	Supply-Side
Section 12I Tax Allowance Incentive (12I)	Generic	Generic	Financial	Indirect	Non Competitive	Supply-Side
Support Programme for Industrial Innovation (SPII) and Other	Generic	Generic	Financial	Direct	Competitive	Supply-Side

Incentive Scheme or Support	Population vs Generic	Sector or Technology vs Generic	Financial vs Non-Financial	Direct vs Indirect	Competitive vs Non Competitive	Supply-Side vs Demand-Side
Black Business Supplier Development Programme (BBSDP)	Population	Generic	Financial	Direct	Non Competitive	Supply-Side
Co-operative Incentive Scheme (CIS)	Population	Generic	Financial	Direct	Non Competitive	Supply-Side
Technology and Human Resources for Industry Programme (THRIP)	Generic	Generic	Financial	Direct	Competitive	Supply-Side
Incubation Support Programme (ISP) (Estimated)	Population	Generic	Financial	Direct	Non Competitive	Supply-Side
Export Marketing and Investment Assistance (EMIA)	Generic	Generic	Financial	Direct	Non Competitive	Supply-Side
Special Economic Zones and Industrial Development Zones	Population	Generic	Financial	Direct	Non Competitive	Supply-Side
Sector-Specific Assistance Scheme (SSAS)	Population	Generic	Financial	Direct	Non Competitive	Supply-Side
Higher Education Institutions (Innovation)	Population	Generic	Non-Financial	Indirect	Non Competitive	Supply-Side
Small Enterprise Development Agency :Technology Programme (Tech Transfer)	Population	Sector	Financial	Direct	Non Competitive	Supply-Side
Small Enterprise Development Agency	Population	Sector	Financial	Indirect	Non Competitive	Supply-Side
Research, Development and Innovation	Population	Generic	Financial	Indirect	Non Competitive	Supply-Side
Internal Resources & Cooperation	Population	Generic	Non-Financial	Indirect	Non Competitive	Supply-Side
Human Capital and Knowledge Systems	Population	Generic	Non-Financial	Indirect	Competitive	Supply-Side

Incentive Scheme or Support	Population vs Generic	Sector or Technology vs Generic	Financial vs Non-Financial	Direct vs Indirect	Competitive vs Non Competitive	Supply-Side vs Demand-Side
Socio-Economic Partnerships	Population	Generic	Non-Financial	Indirect	Non Competitive	Supply-Side
Research outputs	Population	Generic	Non-Financial	Indirect	Competitive	Supply-Side
Earmarked Funds	Population	Generic	Non-Financial	Indirect	Non Competitive	Supply-Side

Based on the policy instruments listed in Table 5, the total expenditure across the three government departments is approximately R 15 billion. Figure 6 shows the aggregated expenditure per category within the OECD framework, with supply side instruments making up approximately 96% of the mix.

Figure 6 – South Africa expenditure on Innovation (2014/15)

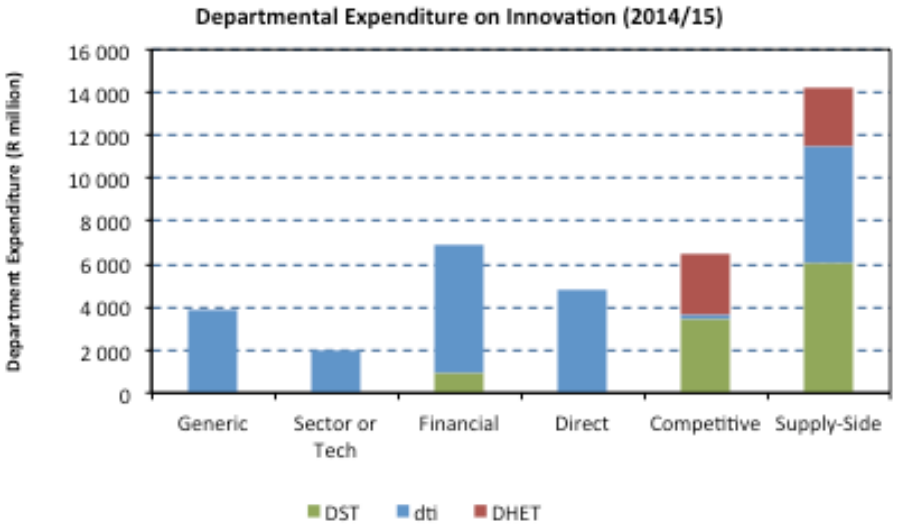
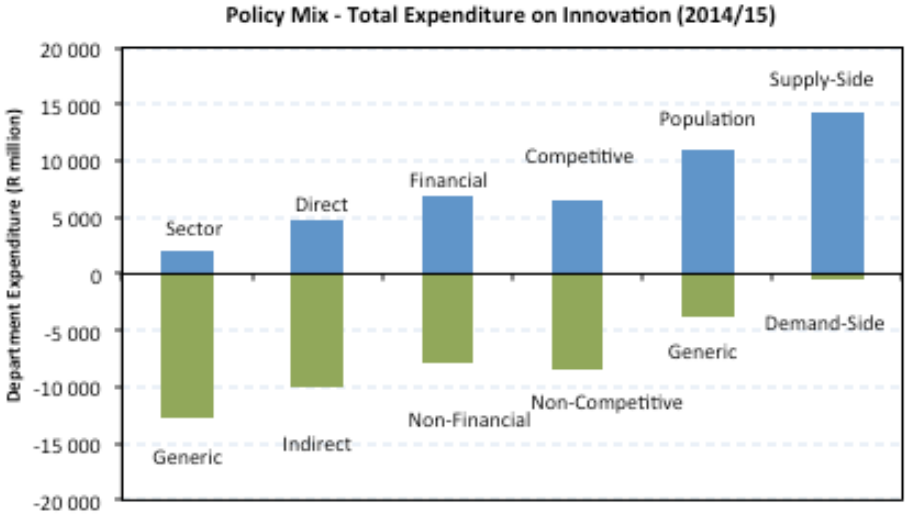


Figure 7 shows how South Africa's policy mix is currently configured. South Africa employs more generic rather than sector based instruments. The policy mix also favours population targeted instruments and is heavily dominated by supply side instruments.

Figure 7 – South Africa's innovation policy mix (total public expenditure)



It is also useful to examine how each of the three departments that were considered in this study contributes to the innovation policy mix in the sector. Figure 8 shows the configuration of innovation policy based on expenditure from the dti. Figure 9 shows the configuration of innovation policy based on expenditure from the DST. Figure 10 shows the configuration of innovation policy based on expenditure from the DHET.

Figure 8 – South Africa's innovation policy mix (the dti expenditure)

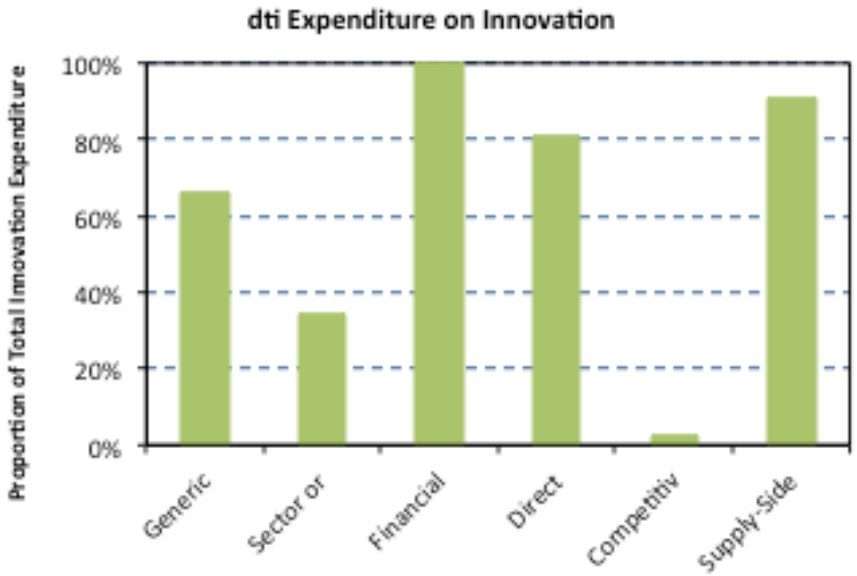
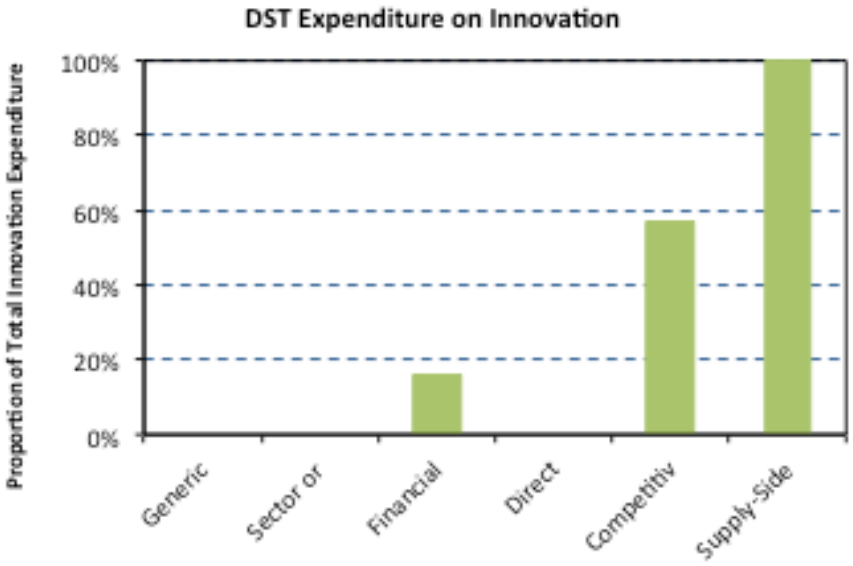


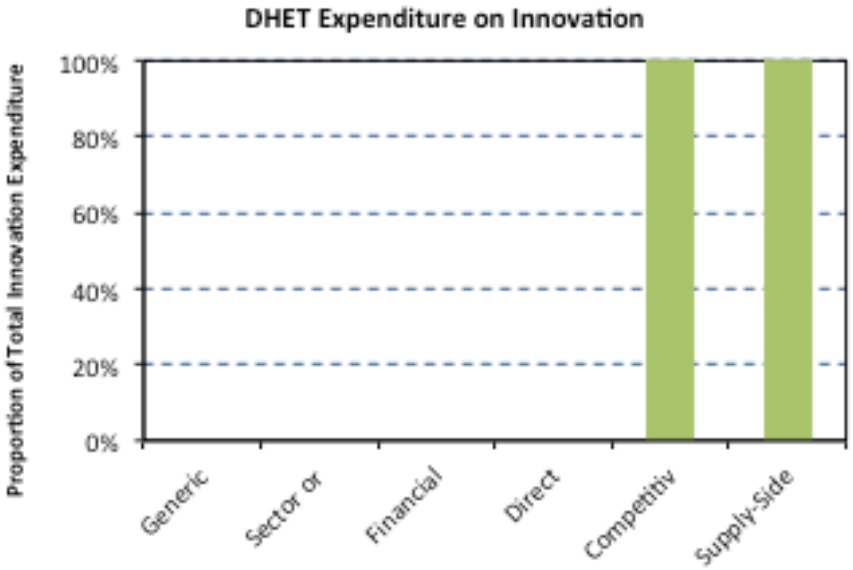
Figure 8 shows that financial, direct and supply side instruments mostly dominate the dti expenditure. Competitive instruments are used very little with only 3% of the mix coming from competitive instruments.

Figure 9 – South Africa's innovation policy mix (The DST public expenditure)



In contrast to the dti innovation policy mix profile, competitive instruments heavily dominate the DST's profile. All of the instruments applied by the DST are supply side instruments.

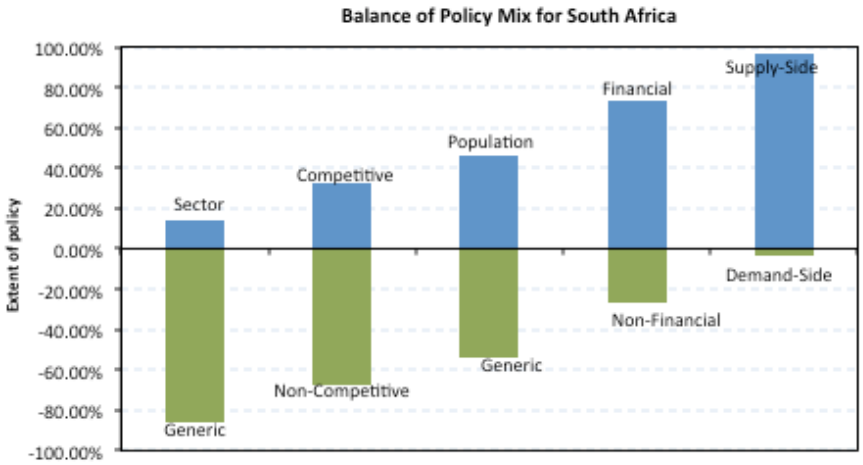
Figure 10 – South Africa's Innovation policy mix (The DHET public expenditure)



The instruments applied by the DHET are all competitive supply side instruments as shown in Figure 10. In the case of DHET expenditure, only research outputs were considered as a part of this study, so the result that the expenditure is concentrated on competitive and supply side instruments is expected.

Figure 11 shows how South Africa's current innovation policy mix is currently configured in terms of percentage of total spending.

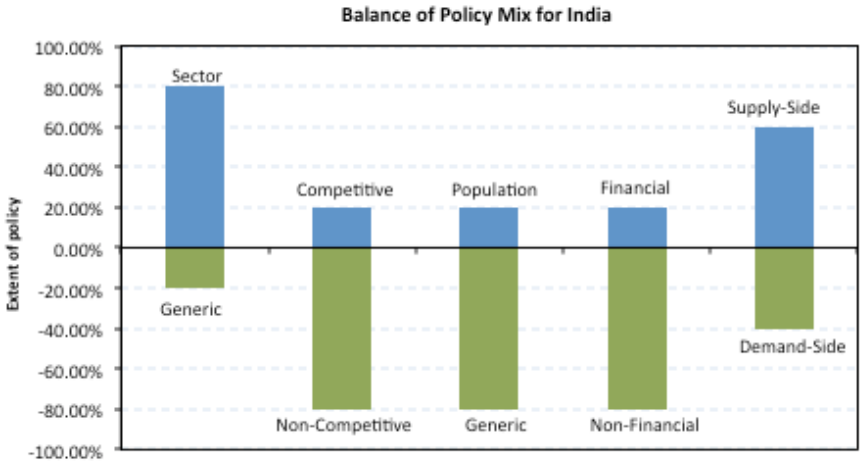
Figure 11 - Balance of innovation policy mix for South Africa



5.4.2 Research Question 1b – India's Innovation Policy Mix

India has a policy mix that is mostly sector or technology specific, non-competitive, generic and non-financial. There appears to be a balance between supply-side instruments and demand-side instruments, with the balance slightly on the supply-side. Figure 12 shows the configuration of India's policy mix.

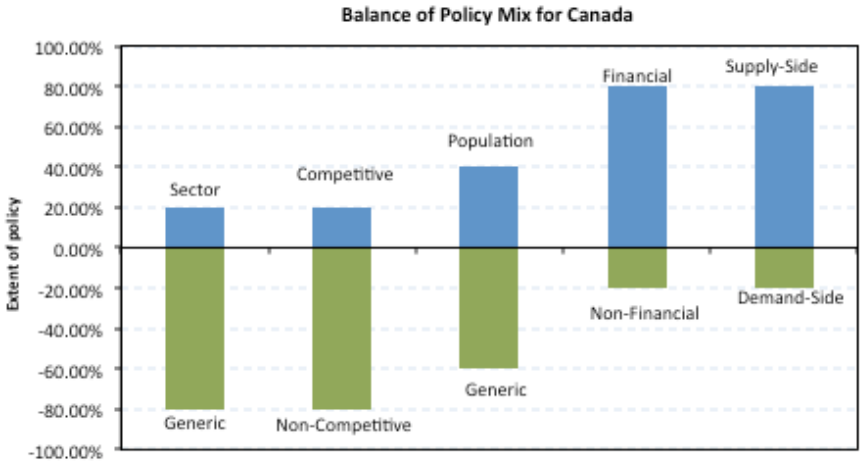
Figure 12 - Balance of innovation policy mix for India



5.4.3 Research Question 1c – Canadian Innovation Policy Mix

Generic rather than sector or technology specific instruments dominate Canada's innovation policy mix. Financial and supply-side instruments are also favoured. There appears to be a balance between population targeted and generic instruments, with generic instruments slightly favoured over population-targeted instruments. Figure 13 shows the innovation policy mix for Canada.

Figure 13 - Balance of innovation policy mix for Canada

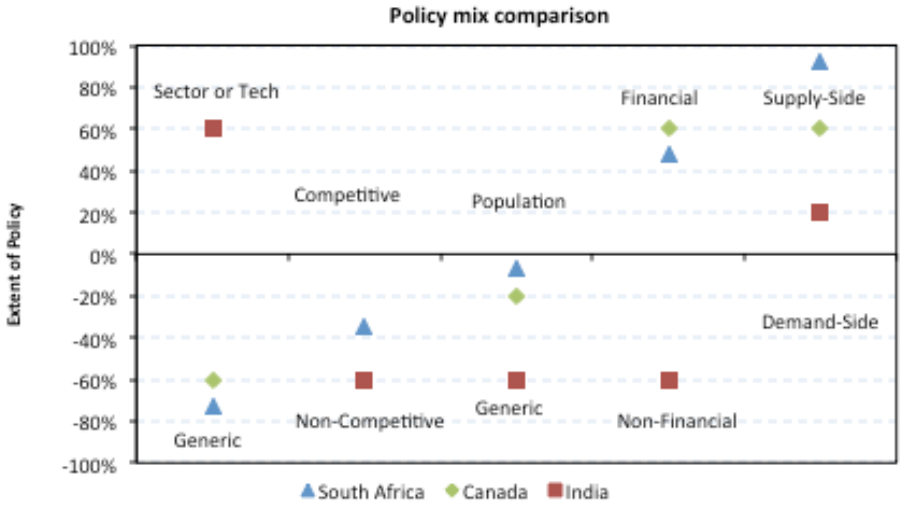


5.5 Research Question 2 – Country Comparisons

Figure 14 shows the comparison of innovation policy mix between South Africa, Canada and India. The policy mix profile of South Africa is very similar to that of Canada. India in contrast

places more emphasis on the use of non-financial and sector or technology-targeted instruments.

Figure 14 - Innovation policy mix comparison between countries

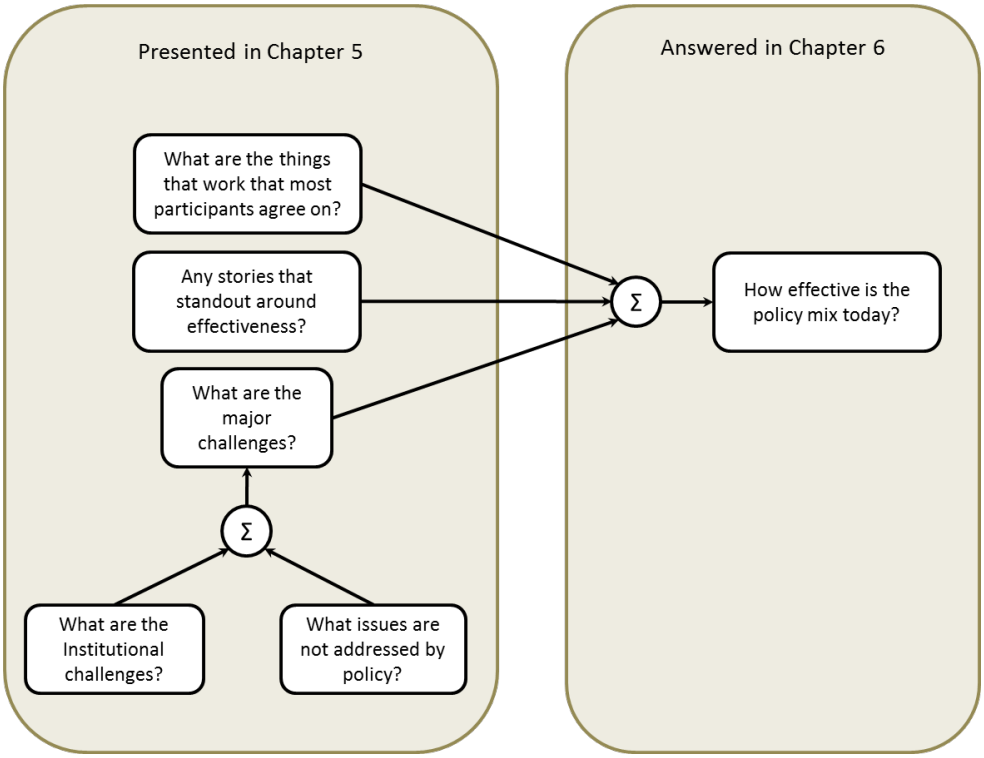


5.6 Research Question 3 – Policy Effectiveness

Research question 3 examined how effective South Africa's approach has been in addressing economic growth within the manufacturing sector. The interview participants were asked to provide their view on how effective South Africa's innovation policy instruments have been for their organisations, and the economy at large. The meaning of effectiveness within the context of this study was clarified for all the participants as the "benefit of the policy instrument outweighing the cost of implementing the policy instrument".

The results that are used to analyse question 3 are presented using the framework in Figure 15. Firstly the concepts dealing with the positive elements of policy on which the majority of the participants agreed are presented. It is however evident that there are various challenges with innovation policy that hinder the effectiveness of policy intent. The concepts that emerge from this are presented by examining two constructs that have emerged from the interviews. The first is the institutional challenges around policy implementation, and the second examines what the current policy mix does not address. Then some of the individual stories that demonstrate the positive effects of policy on the company and on the sector are presented.

Figure 15 - Framework for presentation of data (RQ3)



5.6.1 Points of Agreement Between Majority of Participants

Tax incentive schemes were identified as one of the most effective mechanisms in place to incentivise innovative activities within the sector. Among the reasons given for this was that such schemes were either well understood by the participants, or could easily be outsourced to consulting firms.

> *"It's working well for us. That's a brilliant incentive. For me that's a good incentive. So what that one allows you is that you can essentially claim 1.5 times your R&D investment as a tax deductible. It's an on-going one. We are still making use of it. I think it works well. And it has an impact. We actually budget for R&D because this incentive is there. So there's on-going R&D in our business. I would not say primarily, but this assists us in growing and having a higher R&D budget. We would take this tax incentive into account when we invest."* – (P8)

> *"We used it for the last three or four years. It's working well. It does not refund us as much as we would like, but it works. I think it's difficult if you don't have a consultant helping you."* – (P11)

> *"The tax incentive has worked very well. Finance submits for us based on our R&D spending."* – (P7)

While there was general consensus among all the participants that the various policy instruments do not achieve all of the intended goals, several participants have indicated that they can be effective mechanisms to encourage innovation within the sector.

> *"If I look at our product ranges and the history of our business and our COTS products, that was a nice impact from SPII."* – (P8)

> *"Actually very effective. Very, very effective, because it did not take money out of the budget that was allocated to the main programme. Because these technologies were key and were meant to become part of the mainstream programme, there was a strong drive to actually turn those technology programmes into applied technologies and then into applicable technologies on the actual aircraft."* – (P2 on R&D tax incentives)

Another key concept that emerged from the interviews was the intent of companies to turn R&D investment into products that actually generates income for them. They view this process as consisting of distinct steps in a process to take a product from development to market, and expect policy instruments to support them all the way through. There was general consensus that some of the aspects of that process are well addressed by the mix of policy instruments available, and some are neglected. The areas that are well addressed are the early development of products and technologies through tax incentives, and also through agencies such at Technology Innovation Agency (tia).

> *"Maybe if I were to segment it, you get research, then you get development and then you get manufacturing. So that development component that sits in the middle creates overlap. So you find that research would generally go into development, and you'd find that manufacturing would go into development."* – (P8)

There are also instruments that support access to market that have been effectively used by companies. The Export Marketing and Investment Assistance (EMIA) scheme is an instance of such an instrument.

> *"I think it is a very good programme. We used that we used extensively over the years in all our businesses. We're part of the electro-technical export council and I think the link with the Export Council and the dti export funding works. We would probably do one or two international trips or exhibitions a year through EMIA funding."* – (P8)

However, despite these successes, there remains a gap that the participants perceived is not addressed effectively. There appears to be difficulty in accessing policy instruments that take R&D projects through the final phases of development into products that can generate income for the company.

5.6.2 Major Policy Challenges

A major issue that was raised by the majority of participants is the discontinuity on policy instruments between R&D and actual product development. While the evidence from the interviews show that there is general satisfaction with the instruments that deal with the early phases of development, there is consensus that a chasm exists between the R&D phases, and taking a product to market. This gap exists between the two departments that manage the innovation policy mix. The Department of Science and Technology (DST) incentivises early stage R&D efforts. The Department of Trade and Industry (dti) promotes the development of industry capability. Despite the common overarching societal goals of these two departments, there seems to be an overlapping area that remains largely unaddressed between these two departments.

> *"A lot of these policies however sit under the dti jurisdiction or ambit. Basically we were still not taken into the dti fold or transferred into the dti. That was a major dilemma. We proposed that we fit into the dti arena, but could not get government to do that. We were still in the phase of the design and development phase, howver the reality was that because we changed out strategy we should have had a very strong handover framework between the seed funding which primarily came out of the DST, moved over to TIA, then basically the IDC who did the venture capital."* – (P3)

> *"… so we split the project into phases: Developing, industrialising, and then introducing it into the field. They will consider the development, and maybe the industrialising for funding. But the other part is missing."* – (P11)

One participant indicated that they were unable to bridge this gap despite attempting to engage in a risk sharing co-funding arrangement.

> *"But we did not actually get the money. We did not qualify for it even though in our minds it was something that was there. The reason that we did not get it was that they found that the risk of the technology was too immature. There was too much risk for them to invest in us. It was too far away from a level of maturity to take to industry, it was too far away from being a product. Even the instrument that TIA offered, to them they found that there was too much of a risk. So in that scenario we proposed that we pay 50% of the technology and they pay 50% of the technology so they would help fund us. Even in that scenario they would not assist us. This was with TIA specifically 50-50."* – (P4)

The participants expressed that there appears to be insufficient coordination between the policy instruments that deal with R&D and those that deal with manufacturing and production. This indicates a lack of coordination between the government departments that administer the various instruments. Despite the strong institutional structure provided by the National System of Innovation (NSI), there is still a misalignment in the implementation of the policy instruments offered by each of these departments.

> *"I personally believe that although there is good intent by dti and government at large, there is strong chasm that is missing. That is for SA to grow the cake, we cannot only be involved in the manufacturing sector. We have to be involved in the design and development arena."* – (P3)

While the chasm between R&D and production was an overwhelming area of concern for the majority of participants, there was also consensus that a much deeper problem existed. The poor administration of the policy instruments emerged in all of the interviews conducted. Many of the participants expressed extreme frustration regarding the administrative procedures.

> *"You cannot believe that one person can generate so much paper. And the dti just does not respond. Five Years. Five years, that's what it takes. We applied for R2.5m We wanted to put a bunch of machines in here, wanted to really upgrade. Eventually we got R530k five years later. It's so frustrating, it's unbelievable. Is it effective? It is. But don't expect it to happen anytime soon."* – (P9)

> *"I think that the biggest stumbling block was the administration, so I think that it needs to be a lot clearer in terms of what the requirement is…"* – (P5)

> *"We've actually looked at this but have not had much success. The other challenge we've had in terms of getting funding from government is that it's not as simple as going to them and saying "please can I have money". That whole process is in itself not conducive to the intent."* – (P6 on MCEP)

It is also evident from the interviews that the industry does not have a basic awareness of the entire policy mix. They are able to get to understand some of the different instruments in isolation, but there is not a holistic view of how these instruments interact with each other to achieve the overall goals of government. This emerged in the interviews as a communication failure between government and industry. Participants view the lack of awareness of the policy mix as simply an issue of lack of communication from the side of government.

> *"No, because firstly we are unaware that they even exist, and even if we did we have no idea how to initiate or engage with the people that are involved with these policy instruments."* – (P1 when questioned about why they did not apply any of the policy instruments in their business to date.)

> *"One of the key organisational drives is to find out the rules and understand it and try to use it to the best of our advantage. We've been largely self-funded in terms our research and development to date. But I think there are opportunities to exploit other sources of funding"* – (P10)

Each participant was aware of a the existence and the intent of specific instruments, but they were not aware of the interplay between these instruments to enable them to apply the policy instruments to gain the maximum benefit out of the synergy between the various instruments. Awareness of the policy mix emerged as a key theme from the interviews. Participants have realised that they need to have an understanding of the complete policy mix, rather than just isolated instruments in order to effectively utilise them.

> *"So we've put together research and development processes, and part of the process is to understand funding and look into government funding instruments. I think that part of the problem is how do you learn about it. How do you know about it? So that is one of the tasks that I've given the CTO. Go find out what is available in what institutes, and then learn the rules around that and do we fit into these*

rules? I spoke to someone from [another company], and he said that they received a million here and a million there, and managed to fund some work. And I though wow, that's brilliant. Why don't we access some of this funding? But we have not been able to get our hands on this and understand the rules around this." – (P10)

"So unless you very close to the CSIR or something you're not going to learn about it, so awareness is a key issue." – (P10)

Participants also highlighted the importance of the different agents within the NSI playing their specific role. The policy instruments should be targeted at achieving that and ensuring that the various institutions are performing the function that is required for an effective NSI. It was highlighted that the importance of collaboration between the actors in the NSI.

"So not really directly, but the word in industry is that research institutes are competing in that D block. So if one could solve that…" – (P8)

5.6.3 Standout Stories

The Automotive Incentive Scheme (AIS) was found to be particularly effective with large volume production incentivised through the scheme.

"In general within the automotive sector the benefits outweigh the cost, otherwise the automotive sector will not be using the incentive schemes. They are still using the incentive schemes." – (P3)

A strong sentiment was expressed around instruments that aid companies in adding to their product portfolio. Participants expressed that the instruments that government offers should work together to help take a project from the development stages through to creating a new product offering for the company. In one instance, Support Programme for Industrial Innovation (SPII) had helped seed a new business unit for a company.

"The one project is our commercial of the shelf products. We currently have a product range, which we sell globally that was sort of seeded by a SPII project. So that helped to seed this business. If I look at our product ranges and the history of our business and our COTS products, that was a nice impact from SPII." – (P8)

One participant, P1, who was not yet using any of policy instruments stated that they would rather see more emphasis on instruments that aided them in gaining access to a market,

rather than instruments that helped develop new products. This was a key theme that featured among the participants from companies that considered themselves "small businesses".

> *"A lot of the manufacturing sector at this level is private and its not very regulated with no real market access. As a young company prototyping, you don't really have access to a market. Government wants to boost employment in the country, and the best way to do that is for more business to grow and develop so that you can create more jobs. That speaks to the small businessman, and hopefully you can scale up and employ more people. But accessibility to those small businesses is not great."* – (P1)

Participants who did manufacturing within the defence sector also noted the exclusionary nature of some of the instruments on defence related activities.

> *"Much of these incentives do not apply to the defence industry."* – (P7)

> *"Defence previously was not considered part of the automotive sector. And I say previously because I know that there is a lot of work currently happening to try and include the defence automotive development or manufacturing as part of these schemes so previously we were not allowed from a defence side to leverage of these instruments."* – (P5)

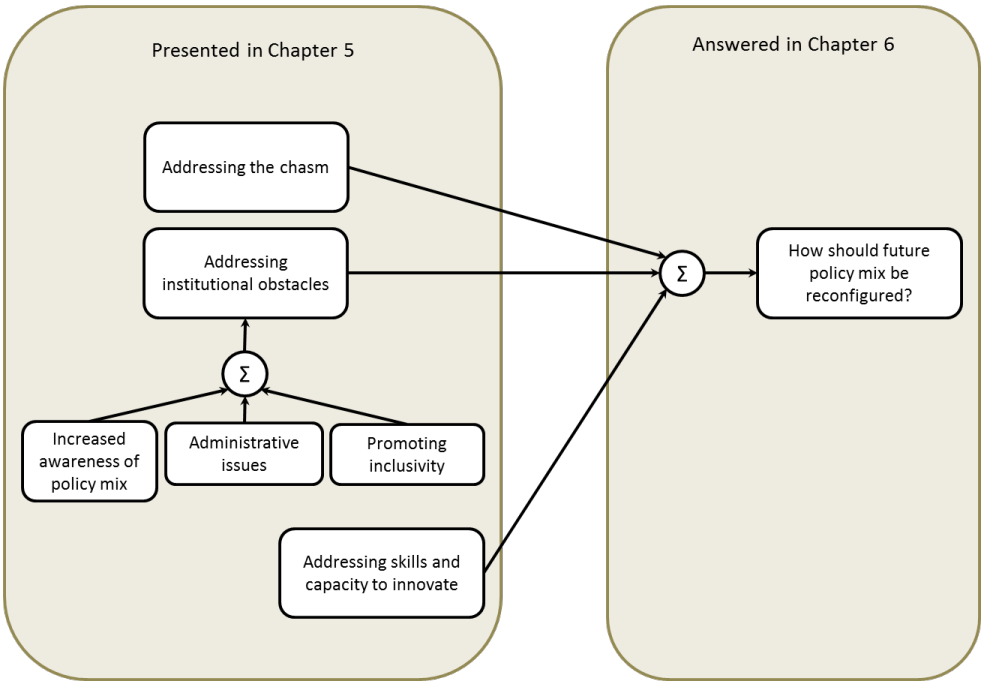
5.7 Research Question 4 – Future Innovation Policy Mix

Research question 4 examined how future innovation policy mix should be configured to improve the outlook for the South African manufacturing sector. The interview participants were asked to make recommendations on what government should do in order to make policy more effective for the sector. This question immediately followed the question regarding effectiveness of policy, and therefore the participants ended up primarily focussing their recommendations on the problems and gaps that were identified as part of the research question 3.

The results that are used to analyse research question 4 are presented using the framework in Figure 16. Firstly the concepts dealing with addressing the chasm will be presented. The institutional obstacles identified in research question 3 resulted in participants making recommendations around three key areas. These are awareness of policy mix, administrative issues between departments, and promoting inclusivity. Finally one of the themes that

emerged during the interviews was a recommendation regarding policy being used as a means of increasing the national capability to perform innovative activities.

Figure 16 - Framework for presentation of data (RQ4)



5.7.1 Addressing the Chasm

There was a general feeling amongst the participants that there needs to be more access to instruments that allow companies to innovate across the full product development cycle from R&D to full-scale production. Some of the participants had used R&D incentive schemes, without being able to access any of the instruments that allowed them to take the product into a production phase. Others were able use policy instruments to develop production capabilities, but not access the R&D funding instruments. There was also the problem of bridging the gap between R&D and production that the participants referred to as a chasm that needed to be crossed in order to get the full benefit of the range of instruments that are available. The participants therefore all expressed similar recommendations for policy to cover the full spectrum of the development process.

> *"The current R&D policy is actually for R&D work, but there is not really much that takes that R&D towards full-scale production. There is a chasm between R&D and production. This is where design and development incentives will bridge the gap between R&D and production." – (P7)*

"And where we battled with is… we do a lot of development on products. We develop it in phases. We put out the product and then add more features. That part we cannot claim." – (P11)

"The real issue on the table is that policy is primarily driven for production related organisations. What DTI has not catered for is the earlier stages. If we are to play as a competitive player in the local or global phase, the policy must be altered, or new policy introduced for the earlier phases, which really don't exist. So they should have a policy framework that allows design and development to take place, even if it is completely innovative. Policies that incentivise new product development, rather than getting into what I call the industrialisation and production. Because you can only use that if you have a design that you can produce." – (P3)

The participants who have done work on defence related projects however seem to recognise that the Department of Defence (DOD) seems to address this chasm through directed technology funding mechanisms that bridge the gap between R&D and eventual production. Participant P1 suggested that the dti adopt a similar approach to that of the DOD.

"… but the same sort of incentives for ensuring design and development funding, seed funding, directed technology funding because of the high tech nature of an attack helicopter, you just don't need money coming out the acquisition phase. You need directed technology funds to ensure that you can develop products that remain competitive to either current or leading edge technologies." – (P2 talking about how the dti could bridge the gap by learning from the DOD)

The there is general consensus among the participants' responses that the different intent of the DST and the dti needs to be linked through effectively formulating policy that overlaps these areas. The two departments should actually have complimentary policies, rather than conflicting policies.

5.7.2 Addressing Institutional Obstacles

Participants identified that a large contributor to the administrative challenges experienced arose from either a lack of communication or awareness of how policy intent was implemented. Participants recommended that this be better communicated, not just in terms of the administration of single instruments, but also in terms of how the various policy

instruments were intended to support each other. Participants felt that this would enable companies to make use of a basket of instruments, rather than a single favoured instrument.

> *"Communication of the instruments is also a hurdle. Not everyone is aware of it. I know I mentioned that my background is defence manufacturing, but I also got a little bit of exposure into mining equipment manufacture. From the dti cluster meetings that I sat in, very few, especially the smaller companies have visibility or have awareness of the policy instruments that are available although they could probably benefit the most. So I think communication on the availability of these instruments and how to make use of it is something that we can improve on."* – (P5)

> *"Innovation policy as a whole... If we were aware of the opportunities for funding… Communication would be the biggest impact. Inform us what options there are and what avenues there are and secondly relieve us of the bureaucracy. That in itself will allow us to focus on innovation rather than compliance."* – (P6)

Participants also highlighted the importance of collaboration between the actors in the NSI. Policy needs to ensure that the right instruments are targeted at the right actors within the NSI.

> *"What I see is that the research institutes are quite effective in getting funding from certain sources and industry is not. And how can you get industry also involved. And maybe TIA is one source that can research and industry closer, but I've yet to see one example where that worked. I think there's chasm that exists between research and industry. And I think that where it comes from is that there's a huge overlap between R&D and manufacturing. So what you find is that… Maybe if I were to segment it, you get research, then you get development and then you get manufacturing. So that development component that sits in the middle creates overlap. So you find that research would generally go into development, and you'd find that manufacturing would go into development. And if one could find a suitable way to cover that. So not really direct, but the word in industry is that research institutes are competing in that D block. So if one could solve that." – (P8)*

> *"A lot of the manufacturing sector at this level is private and its not very regulated with no real market access. As a young company prototyping, you don't really have access to a market. Government wants to boost employment in the country, and the best way to do that is for more business to grow and develop so that you can*

> *create more jobs. That speaks to the small businessman, and hopefully you can scale up and employ more people. But accessibility to those small businesses is not great."* – (P1 talking about needing to compete with more established institutions for access to funding instruments)

Participants also expressed the desire for the governance structures to ensure that policy instruments are applied towards their intended ends. The use of R&D funding for product development activities, and product development funding for R&D activities was also viewed as an obstacle the policy makers as whole need to address.

> *"Very few industries are doing research. What's the output of research? It's a publication. What companies are publishing? What's the output of development? It's a product. How many research institutes are spending money on product design. They would say that it's a prototype and it's greenfields. The reality is that it's a product."* – (P8)

> *"For me that is the key to getting collaboration between research and industry if you can solve that in-the-middle block."* – (P8)

Inclusivity in the policy making process was viewed by participants as an important contributor towards effective policymaking. The participants perceived government as making and implementing policy without a real knowledge of the industry. It was strongly suggested that industry be involved in the formulation of innovation policy, with one participant providing a tangible example of where has previously worked.

> *"[Company name removed] played a crucial role in writing the IPAP policy for South Africa. That is because we played in that space and understood the aspects of electric vehicles. Policies can only be written by companies, or individuals, or departments within government that fully understand the technical aspects of how that sector needs to operate, even if it is a sub-sector. Otherwise policies are not effective."* – (P2)

> *"People who make decisions on behalf of business haven't the slightest clue what it takes. They don't understand. The people who make the policy decisions should actually interact with business. And I'm talking about the people at our level. Have people empowered and knowledgeable develop the policy."* – (P9)

> *"Firstly, to understand the landscape of the way businesses – I can only speak for new businesses because that is what I know – the way that businesses are starting up are very different to the way businesses have been starting up 5 to 10 years ago. I don't think government has caught up to accessing business owners in a way that is simple to them."* – (P1 talking about policy makers' understanding of the challenges that new business faces)

Participants also observed that some policies are exclusionary, and want more inclusivity based on the technical scope of the project that they are executing, rather than just the social merit of the policy intent.

> *"We're just starting to scratch the surface on this. The first challenge is that as the rules come about, it just disqualified us. And I say this with the greatest respect, they are mostly BEE focused. They are aimed a specific sector or a specific group, and it disqualifies the rest of us. It's not done on the technical merit of what you want to do. It's done on the social merit of the outcome, than it really is innovation driven."* – (P10)

The exclusion of defence related projects was also a problem that some participants experienced. It was suggested that projects rather be considered for their value add to the manufacturing sector, rather than just be excluded because they are defence related projects. Considering the innovation policy mix would play a big role in addressing this.

> *"Defence previously was not considered part of the automotive sector. And I say previously because I know that there is a lot of work currently happening to try and include the defence automotive development or manufacturing as part of these schemes so previously we were not allowed from a defence side to leverage of these instruments."* – (P5)

5.7.3 Addressing Skills and Capability to Innovate

Participants observed that many of the policy instruments were focused on developing technology, or on developing infrastructure through capital equipment procurement. Participants noted that the development of skills was as important for capability building as technology or equipment. Participants expressed a desire that skills development needs to be integrated into the policy framework as part of the policy mix, rather than implemented as a separate initiative.

"I'm looking at the MCEP. We need the skill set. That's what's lacking. Not just capital infrastructure. I currently cannot bring all of our manufacturing into the country. We don't have the skills. We don't have the manpower. And I can go down that road, but we don't have the skills. But skills is not a degree or technikon diploma. Skills is real skills. It needs to be real. It's about being able to do real things. Things like soldering skills needs to be developed." – (P11)

"We don't have tradesmen. Apprenticeships should be given more stature through policy. Companies used to be given a tax incentive to train artisans. More policy instruments to incentivise training of artisans and tradesmen." – (P9)

5.8 Conclusion

The results presented show how South Africa's innovation policy mix is configured, both in terms of actual expenditure and also the relative percentage spending on the various policy instruments. The OECD framework described in Section 2.7 was used for the characterisation and to graphically present the results. The results show that South Africa's innovation policy mix contains more generic rather than population targeted instruments. The innovation policy mix also contains more generic rather than technology specific instruments. Non-competitive and non-financial instruments are favoured. Supply-side instruments rather than demand-side instruments dominate South Africa's innovation policy mix.

The comparator countries' innovation policy mix is presented only in relative percentage terms, as this data is used only for the purposes of comparison. India has a policy mix that is mostly sector or technology specific, non-competitive, generic and non-financial. Generic rather than sector or technology specific instruments dominate Canada's innovation policy mix. Financial and supply-side instruments are also favoured.

The effectiveness of innovation policy mix was assessed through interviews, and a key theme that emerged from the participants was that there appears to be a chasm between R&D and eventually manufacturing and producing a product. The participants have either very effectively used the R&D incentives offered by the DST, or they have used the manufacturing and production incentives offered by the dti. There is a general agreement among the participants that the policy offerings by these departments do not work well together.

Training and skills development has also emerged as one of the themes from several of the participants. The need for artisan and tradesmen was highlighted, and although there are

policy instruments to incentivise skills development, the participants expressed that this was an area that is not adequately dealt with.

Institutional challenges such as the administration of the various policy instruments were highlighted as a hurdle towards effectively applying the basket of policy instruments on offer. The lack of awareness of the policy instruments on offer further compounded this problem.

Participants expressed the need for policy instruments to complement each other allowing a firm to take a product from R&D towards a manufacturing and production. The need for a holistic view of the various policy instruments and how they interacted with each other was apparent. The coordinated administration of the entire basket of policy instruments also emerged as strong recommendation for government.

Chapter 6: Discussion

6.1 Introduction

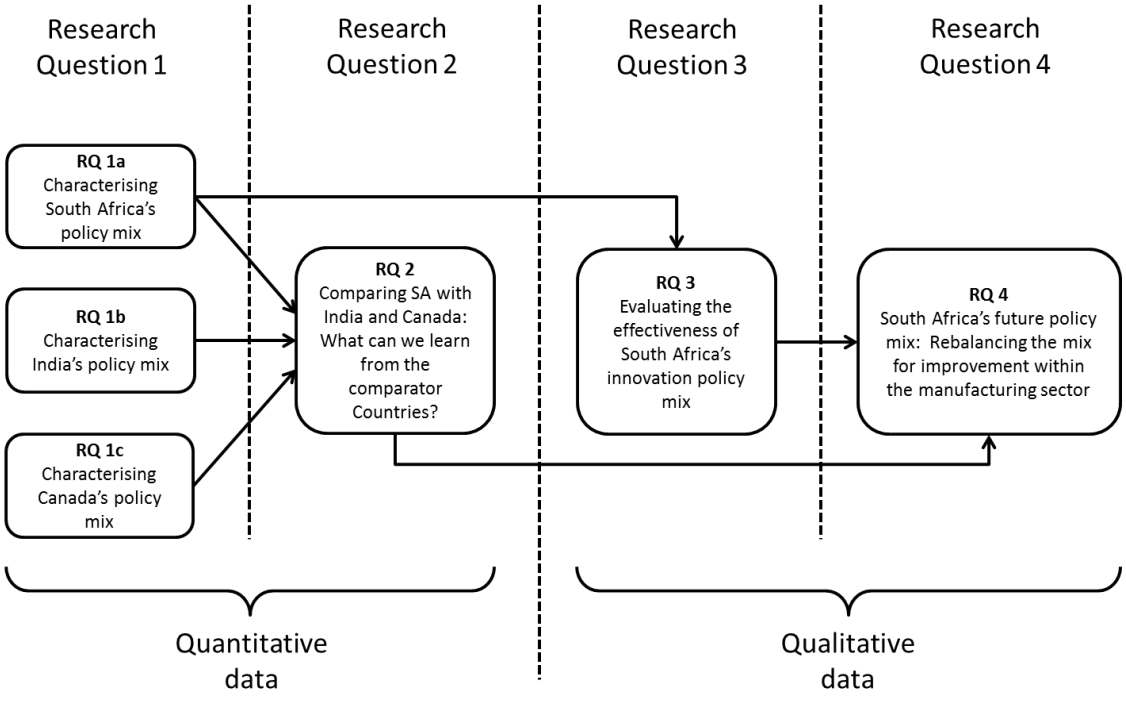
Chapter 5 presented the results for this study based on the quantitative and qualitative data that was collected. This chapter discusses these results within the context of the research questions that have been posed in Chapter 3.

The research questions that are discussed in this chapter are:

1. Characterise the current innovation policy mix for South Africa and the comparator countries:
    a. What is the current innovation policy mix for the South African manufacturing sector?
    b. What is the current innovation policy mix for the Indian manufacturing sector?
    c. What is the current innovation policy mix for the Canadian manufacturing sector?
2. How does South Africa's innovation policy mix within the manufacturing sector compare with the policy mix for the manufacturing sector of other comparator countries?
3. How effective has South Africa's approach been in addressing economic growth within the manufacturing sector?
4. How should a future innovation policy mix for South Africa be configured in order to improve the outlook for the manufacturing sector?

The answer to research question 1 provides insight that assists in answering research question 2 and question 3. Research question 2 and question 3 in turn assists in answering research question 4, where some recommendations emerge as to how South Africa's innovation policy mix could be rebalanced to improve the outlook for the manufacturing sector. The logic of the argument presented in this chapter and the relationship between the research questions is shown graphically in Figure 17.

Figure 17 - Relationship between research questions



6.2 Research Question 1 – Characterising the Policy Mix

6.2.1 Research Question 1a – South African Innovation Policy Mix

The dti, the DST and the DHET are the three main government departments that primarily manage South Africa's innovation policy. Table 3 shows a listing of the policy instruments that are employed by the South African government, and also the government department that these instruments belong to. This study focussed on the manufacturing sector, and therefore instruments that did not contribute that that sector were not considered. Government expenditure on each of these instruments were analysed and allocated to the categories within the OECD framework. Table 5 shows this categorisation, and Figure 6 shows the actual expenditure of each of the three government departments within each category.

It is apparent that South Africa's innovation policy is heavily dominated by supply-side instruments. Borrás and Edquist (2013) point out that the choice of policy instruments needs to be made with the goal of solving a problem that has been identified within the NSI. Instruments must be customised and combined with complementary instruments (Borrás & Edquist, 2013). South Africa has identified the need to increase competitiveness within the manufacturing sector as one of the key issues that need to be addressed through the

application of innovation policy instruments (Organisation for Economic Co-operation and Development (OECD), 2014). This is to be achieved by implementing a portfolio of R&D programmes to develop the industry (Organisation for Economic Co-operation and Development (OECD), 2014). South Africa's supply-side focus is implemented with this goal of improving competitiveness within the industry. Whether the reliance on supply-side instruments to achieve this goal has been effective is to be determined, and is explored further in research question 3.

The South African Government has identified the low industry financed R&D expenditure as an indication that industry-STI linkages need to be improved by providing incentives that increase R&D effort and commercialisation of innovation (Organisation for Economic Co-operation and Development (OECD), 2014). The dti's spending on innovation policy instruments is heavily financial and also mostly generic rather than population targeted. Competitive instruments are hardly used by the dti (Figure 8). Borrás and Edquist (2013) list financing of innovation activities, commercialisation and knowledge transfer activities among the key activities within a well functioning NSI. The emphasis on financial innovation policy instruments offered by the dti encourages this. However, there are also other activities that Borrás and Edquist (2013) list as key activities that are non-financial such as incubation activities, consultancy services and access to legal services. Due to the strong financial focus of the incentives that the dti offers, there is a risk that these activities may receive less attention than is required to close the gap between R&D and eventually turning that R&D into products.

Human capital development has also been identified as a major problem for South African STI advancement, and increasing the pool of human resources for STI has been prioritised (Organisation for Economic Co-operation and Development (OECD), 2014). Policy incentives for tertiary education have not been considered in this study. The research output has been included as this output may end up making a contribution to the manufacturing sector. The DHET funds this type of research output. Figure 6 and Figure 10 show that this funding is made up of competitive, supply-side instruments.

South Africa's goals for STI have been stated in various policy documents and frameworks (Organisation for Economic Co-operation and Development (OECD), 2014). The current policy mix has been set up to achieve these stated goals. South Africa's policy mix can be described as heavily supply-side. The current configuration of policy seems to be focussed on addressing the STI mode of innovation. The question about how effective this approach is, remains to be answered. This will be explored in research question 3.

6.2.2 Research Question 1b – Indian Innovation Policy Mix

The Indian government has identified inclusiveness as a major challenge facing the country, and have structured their policy instruments to address inclusive innovation and generate innovation outcomes that benefit poor and excluded groups (Organisation for Economic Co-operation and Development (OECD), 2014). Figure 12 shows that India's innovation policy mix is more non-financial, non-competitive and generic rather than population targeted. This balance is designed to achieve the goal of innovation inclusiveness.

Environmental sustainability is also identified as a problem that India faces (Organisation for Economic Co-operation and Development (OECD), 2014), and the non-financial measures in particular, incentivises the industry to innovate towards solutions that achieve this goal. The focus on environmental matters calls for technology-targeted instruments, and the investment that India makes in in technology-targeted instruments is evident in Figure 12. India has a well-established renewable energy programme (Organisation for Economic Co-operation and Development (OECD), 2014). Other non-financial measures that contribute to this goal are subsidies offered to companies for to transform existing manufacturing facilities to cleaner, greener facilities (Organisation for Economic Co-operation and Development (OECD), 2014).

Demand side measures also form a significant part of India's policy mix (Figure 12). India utilises public procurement policies as a means to implement this (Organisation for Economic Co-operation and Development (OECD), 2014). Edquist and Zabala-Iturriagagoitia (2012) regard public procurement of innovation as an effective demand-side instrument, but it needs to be combined with other instruments in a mix to achieve the desired objectives. Guerzoni and Raiteri (2015) claim that public procurement as an innovation policy instrument is a growing trend in the literature and argue that the value of such instruments may have previously been underestimated. India appears to be applying this by shifting its balance of innovation policy towards using demand-side instruments in combination with other instruments to achieve its goals.

6.2.3 Research Question 1c – Canadian Innovation Policy Mix

The Canadian government has prioritised entrepreneurial growth, strengthening the country's R&D base and targeting high priority sectors as the key areas of concern for innovation policy (Organisation for Economic Co-operation and Development (OECD), 2014). R&D tax incentives thus form a major part of Canada's the policy mix. Despite this intent of targeting priority sectors, Canada appears to use more generic instruments rather than population, sector or

technology targeted instruments according to Figure 13. The Canadian government has indicated an intent to change the policy mix to better achieve their goals over the coming years (Organisation for Economic Co-operation and Development (OECD), 2014).

Canada's innovation policy instruments are heavily supply-side and also very financial (Figure 13). The Canadian government has invested both financial and non-financial resources towards improving the R&D capacity and capability of the country (Organisation for Economic Co-operation and Development (OECD), 2014).

As a well-developed STI country, Canada's high emphasis on supply side policies is expected. The narrow perspective on NSI theory defined by Johnson et al. (2003) suits Canada's STI objectives, by focussing on the relationships between knowledge institutions and the high technology sectors.

6.3 Research Question 2 – Country Comparisons

Figure 14 shows the comparison of policy mix between South Africa, Canada and India. In order to meaningfully compare the policy mix of each of these countries, it is important to consider their political, technological, economic positioning and their context.

It is apparent that although all the countries have adopted a supply side policy, India seems to be the closest to implementing demand side measures. Guerzoni and Raiteri (2015) regard demand side technology policy as a growing trend in innovation policy. India has adopted this trend by applying innovative public procurement to stimulate a demand for innovation. The emphasis on supply-side policies by Canada can be explained by considering their goal of strengthening their STI base.

Neither supply-side, nor demand-side policies can exist on their own, but must interact with each other to achieve optimal results (Guerzoni & Raiteri, 2015). South Africa appears to be almost exclusively supply-side, while India appears more balanced in their approach. The development goals of India are to improve innovation inclusivity. Similarly, South Africa has a goal to address "grand challenges" for the greatest socio-economic return, and address the entire innovation chain (Department of Science and Technology, 2007). Canada's innovation policy is heavily supply-side, but there are still some demand-side policies that are part of the Canadian mix. A key point that South African policymakers may take from the comparison with India and Canada is the combined use of supply-side policy with demand-side policy. This combined approach is in agreement with the literature presented in Section 2.3.3.

South Africa also has a goal to transform towards a knowledge economy (Department of Science and Technology, 2007). This is a key driver for the DST, and this is an area where Canada has excelled. South Africa is doing well in this regard to almost mimic Canada's innovation policy mix profile (Figure 14). Canada, although not apparent in Figure 14, has indicated their intent to move towards more sector and technology-targeted instruments (Organisation for Economic Co-operation and Development (OECD), 2014). As South Africa approaches this transformation, it may consider a similar move towards technology-targeted instruments. South Africa has identified sectors and technologies that will contribute towards the defined grand challenges (Department of Science and Technology, 2007). India has implemented the sector and technology-targeted instruments in combination with other non-financial instruments to achieve their goals. Effective combination of sector and technology-targeted instruments with non-financial instruments is an area where South Africa can borrow the lessons from India's policy mix.

6.4 Research Question 3 – Policy Effectiveness

Research question 3 examines how effective South Africa's innovation policy mix is. The data presented in Section 5.6 is used to answer this question. In order to evaluate policy effectiveness, it is also necessary to understand how South Africa's innovation policy mix is configured. Research question 1(a) characterised South Africa's innovation policy mix, and will be used as input to answering Research Question 3.

It is important to evaluate the interactions of policy instruments with each other, rather than compare individual instruments against a set of criteria (Department of Arts Culture Science and Technology, 1996; Flanagan et al., 2011; Reichardt et al., 2014). This analysis therefore considers the interaction between different types of instruments in the policy mix, rather than the effectiveness of the individual policy instruments.

There was a general agreement that several of the incentive schemes offered by the government work very well. However, the interview participants also pointed out some challenges. The instruments that appeared most popular to industry seemed to be the financial, non-competitive, supply-side instruments. These seemed to work very well to incentivise firms to invest in R&D. R&D tax incentives are an example of such schemes, which in some instances encourage companies to budget for R&D because the scheme exists and is well managed. Companies, however do not want to do just R&D. They want to turn that R&D investment into income generating products. The dti recognises this need in formulating

policy to actually commercialise technologies into products (The Department of Trade and Industry (the dti), n.d.).

However, there appears to be a gap that exists in the basket of policy instruments between technology development and eventually commercialising a product. It was found that early R&D is very well incentivised, but the product development work that needs to occur to take a product to the market was difficult to achieve with the current policy mix. Companies are reluctant to access venture capital funds or debt funding for this. This is an especially critical area for manufacturing, as the industrialisation phases are not considered to be R&D. One of the reasons for this phenomenon is that the DST primarily drives the R&D incentives, and the dti drives technology commercialisation. The policies from these two departments need to complement each other. The automotive industries seem to yield better results in the area of taking technology through to commercial products. They achieve this primarily through the Automotive Investment Scheme (AIS), which is a demand-side incentive scheme.

Another point of general agreement among the interview participants was that despite the positive intent of policy, poor governance reduces the impact. Participants indicated extreme frustration at the multitude of procedures and process around the administration of the various policy instruments. A possible reason for this is that different government departments administer different policies, each with their own set of rules and regulations. Flanagan et al. (2011) highlight the importance of governance in achieving policy goals, especially in a multi-actor system such as South Africa's NSI.

Participants found that the lack of awareness of the policy instruments and the rules governing these instruments to hinder the effective application of the policy instruments. This lack of awareness stretched beyond simply knowing what instruments were available, but rather towards an understanding of the interplay between the various instruments. The importance of this interplay was stressed in Chapter 2 of this study.

One interview participant suggested that innovation policy needed to ensure that the various actors in the NSI perform their intended function within the NSI. It was suggested that despite the intentions of the current policy mix, the governance structures are not set up to ensure that each actor plays their defined role in the NSI. The DST and the dti have a suit of instruments, each designed to achieve different objectives within the NSI (The Department of Trade and Industry (the dti), n.d.). A key part of this portfolio of instruments is the collaboration that is required between the various institutions within the NSI in order for the

portfolio of policy instruments to be effective. Industry recognises this weakness in the governance, and one interview participant suggested that that this stems from the fact that different parts of the policy mix are administered by different government departments. Increasing coordination between these departments would help improve collaboration between the various actors in the NSI. Participant P8 captured this idea in the following extract from the interview:

> *"… the word in industry is that research institutes are competing in that D block. … the key to getting collaboration between research and industry if you can solve that in-the-middle block." – (P8)*

Interview participants questioned the knowledge of policy makers and policy administrators, and it was apparent that industry knowledge was an important factor in formulating effective policy. The involvement of industry in policy making appeared to be something that was generally missing. Formulating crosscutting innovation policy is difficult, especially in developing countries (United Nations, 2011). The different departments consult different stakeholders, and this could possibly further accentuate the problem of discontinuity in the policy instruments between the DST and the dti.

Interview participants also identified that there were not enough instruments in the policy mix that supported market access. This points towards the strong supply-side emphasis of South Africa's policy mix. Patanakul and Pinto (2014) describe the market based view and the resource based view as drivers of innovation and show that neither view on its own is sufficient to drive innovation. Parrilli and Heras (2016) show that the DUI mode of innovation has a bigger impact on non-technological innovation, such as commercial and market development. The NSI must encourage and enable learning interactions by using policy that uses the DUI mode of innovation. Government needs to implement a portfolio of policies to create the conditions, both within the firm and within the market for innovation to flourish (Patanakul & Pinto, 2014). South Africa's reliance on supply side policies is akin to focussing almost exclusively on the resource-based view to the detriment of the market-based view.

Participants reported a few standout stories during the interviews that showed how companies were able to apply the positive intent of innovation policy to their benefit. One of the companies interviewed actually funded a product range by using the incentives on offer from the DST and the dti. This was however the exception among the interview participants,

rather than a general trend, indicating that despite the challenges that have been discussed, South Africa's innovation policy mix does have the potential to achieve its intent.

In general, the results of this study show that innovation policy is very effective during the early phases of product development, but the policy mix lacks the instruments that are required to support the development of a market for these products. Additionally, there appeared to be a gap in the policy mix between instruments that support R&D, and the instruments that support developing a product for full-scale manufacturing and production. This calls for the innovation policy mix to be rebalanced towards providing more instruments that support the design and development efforts of companies to take R&D into the design and development of products that are ready for the market. Participant, P7 captured this sentiment in the following quote:

> *"The current R&D policy is actually for R&D work, but there is not really much that takes that R&D towards full scale production. There is a chasm between R&D and production. This is where design and development incentives will bridge the gap between R&D and production."* – (P7)

6.5 Research Question 4 – Future Innovation Policy Mix

Research question 4 explores how policy mix could be reconfigured to improve the outlook for the manufacturing sector. Borrás and Edquist (2013) point out that the choice of innovation policy instruments is informed by a diagnosis of a problem within a system of innovation, implying that policymakers need insight into the performance of current policy instruments before formulating new policy. Schneider and Ingram (1988) contend that by comparing policy mix of different countries, it is possible for policymakers to adopt components of policy mix from various sources. Research question 4 therefore builds on the output of research question 2 and question 3 to ultimately address the problem of rebalancing the innovation policy mix to improve support for South Africa's manufacturing sector. This question is answered based on the results presented in Section 5.7 in conjunction with the findings of the previous research questions. Borrás and Edquist (2013) provide three dimensions to the formulation of innovation policy. These are the choice of the most suitable instruments, customising the instruments for the specific context, and finally designing the mix of instruments (Borrás & Edquist, 2013). This research question only addresses the third dimension by dealing with rebalancing the policy mix, rather than the choice or customisation of policy instruments.

South Africa's extensive reliance on supply-side instruments was highlighted as the biggest area to be addressed. Participant P8 captured the need for policy instruments that encourage market development in the following quotation:

> *"For me, if there's one message I could get to government its how could one create a landscape that creates a positive environment for industry." – (P8)*

Research question 2 showed that India has shifted its innovation policy balance towards using demand-side instruments. Research question 2 also showed that Canada had been employing a heavily supply-side innovation policy. Fagerberg and Srholec (2008) warn against the hazard of simply mimicking other policy arrangements without taking into account the political and technological context of the country. It is therefore important to consider South Africa's context, as well as India and Canada's context before applying the findings of research question 2.

India, as a developing economy, has set itself the goal of improving social inclusivity. India has therefore created a policy mix structured to incentivise innovation that contributes towards this goal. Canada, in contrast, is a developed nation with a well-established STI system. Canada has the objectives of strengthening its R&D base. India therefore employs significantly more demand-side instruments, while Canada uses predominantly supply-side instruments. Despite these contrasting approaches from India and Canada, they both employ a combination of supply and demand-side instruments.

South Africa has stated its goals of addressing its socio-economic challenges and also to transform towards a knowledge economy (Organisation for Economic Co-operation and Development (OECD), 2014). The implication of these goals is that South Africa may use elements of the policy from both India and Canada. Currently South Africa's policy mix more closely resembles Canada than India. From a policy formulation perspective, South Africa would need to shift its policy from almost exclusively supply-side towards some demand-side measures. This shift need not be as radical as that of India, as South Africa also has the goal of moving towards a knowledge economy, and must therefore also apply the supply-side measures as Canada does.

Research question 3 exposed the problem of policy instruments not addressing the full product development cycle from R&D to full-scale production. South Africa's policy mix provides access to R&D incentives, without easy access to corresponding instruments that take a product through to market. One participant, P11, captured this by stating:

> *"They see it as product support, but actually we are still developing the product. That's where we lose out a bit. That's something they need to look at."* – (P11)

The gap between the prototyping phase where a product is aimed at an early market, and the final product that is aimed a large mainstream market is known as the chasm (Moore, 1991). The interview participants for this study referred to the chasm that existed in their own organisations, as products were developed in phases with initial prototyping ultimately leading to full-scale production for a large market. An and Ahn (2016) have identified that government policy interventions are useful for industry in crossing the chasm in the commercialisation process. The South African government recognises that addressing this innovation chasm is a crucial step in moving towards the knowledge economy (The Department of Trade and Industry (the dti), n.d.).

One example of a policy instrument that addresses the problem of taking a product towards full-scale production is the Manufacturing Competitiveness Enhancement Programme (MCEP). This scheme is used primarily to upgrade production facilities and skills. Participants expressed that there is a need for policy instruments that encourages the continued development of a product in order to positively complement the MCEP. This translates to adding generic, financial and non-competitive instruments to the innovation policy mix.

Governance was identified as an issue that could turn good policy intent into poor performing policy mix. Issues around administrative challenges, according to the interview participants, stemmed largely from poor knowledge of the various policy instruments. Participants especially highlighted that knowledge of how to apply the complete basket of policy instruments was poor, and government could help ease the administrative burden by taking measures to improve policy knowledge among all of the role players. Participants also called for improved coordination between government departments.

A final area that the interview participants highlighted was skills development. Participants recommended that more instruments promoting the injection of technical skills into the industry be introduced into the policy mix. Such instruments are similar to the Technology and Human Resources for Industry Programme (THRIP). While THRIP focuses on R&D collaboration with tertiary institutions, the interview participants called for similar programmes that focus on developing artisan and technical trade skills. This translates to a policy mix with increased generic, financial and non-competitive instruments.

6.6 Conclusion

The overall objective of this study was to investigate how South Africa's innovation policy mix could be rebalanced to better support the manufacturing sector. Four research questions were formulated and this study was approached using mixed methods. A quantitative approach was applied to research question 1 and question 2. Research question 3 and 4 were approached using qualitative methods. This study started out by first characterising the innovation policy mix of South Africa and the comparator countries based on national spending on the various innovation policy instruments. South Africa's innovation policy mix was then compared to that of India and Canada with the intent of learning from the comparator countries. The effectiveness of South Africa's policy mix was evaluated qualitatively in order to diagnose where to redirect policy effort. Finally the results of the previous three questions, together with primary interview data was used to investigate how South Africa's innovation policy could be reconfigured.

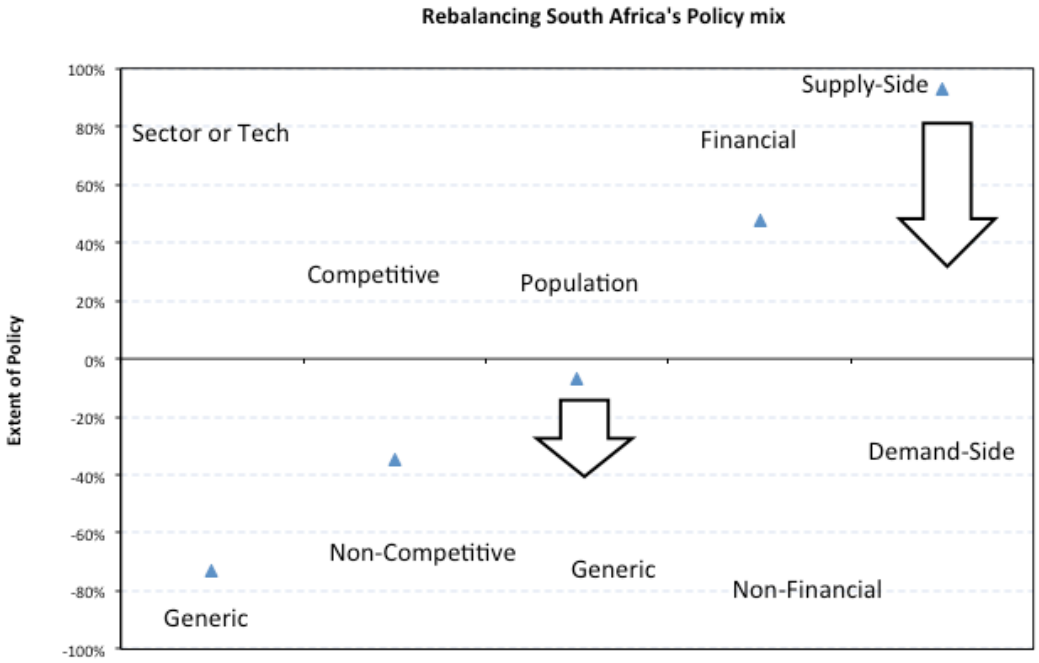
South Africa's innovation policy mix could be described as consisting of almost exclusively supply-side instruments. In contrast to this, India has moved towards using demand-side instruments to support their goal of social inclusivity. South Africa appears to have a similar profile to that of Canada. Canada has set goals to boost its R&D sector, and this aligns with South Africa's goal of transforming to the knowledge economy.

Participants identified that there was a chasm in the product development cycle, and the current policy instruments are inadequate in supporting them to take a product from R&D toward full-scale production. Administration and governance were listed as major challenges, and poor governance diminished the good intent of policy. Lack of sufficient policy instruments that focus on market development was expressed as a concern, and this is evident in the heavy focus on supply-side instruments applied by the South African government.

A key area that South Africa needs to focus on is the reliance on almost exclusively supply-side instruments. South Africa shares some of the challenges of India as an emerging nation. South Africa also shares some common aims with Canada in aiming to transform towards a knowledge economy. South Africa needs to shift their balance toward some demand-side incentives, as both supply and demand measures need to be applied. In addressing the chasm that was identified by the interview participants, South Africa could consider using more generic instruments. Finally, the area of skills development was raised. Participants were

looking for programmes that supported industrial skills development. Figure 18 shows the overall movements that are recommended to rebalance South Africa's innovation policy mix.

Figure 18 - Rebalancing South Africa's innovation policy mix



Chapter 7: Conclusion

7.1 Introduction

Despite continuous investment in research, development and innovation through a portfolio of policy instruments, the South African manufacturing sector has reported a contraction in the sector in 2015. Innovation drives economic development, and the integration of different policy instruments collectively drives innovation and ultimately economic growth. This research aimed to show how South Africa's innovation policy mix could be rebalanced to achieve growth within the manufacturing sector. The OECD framework for characterising policy mix was used in this study.

The study is approached by first understanding how South Africa's current policy mix is configured, before comparing this to a set of comparator countries. The performance of South Africa's current innovation policy mix is evaluated, and this result is used to recommend how future policy could be reconfigured to achieve South Africa's policy goals.

This characterisation and evaluation of policy mix provides researchers and policymakers with the means to better understand how the different types of policy instruments interact with each other to stimulate or inhibit economic growth. Such an understanding also gives policymakers a basis for more effective policy formulation.

7.2 Summary of Main Findings

7.2.1 Research Question 1 – Characterising the Policy Mix

Supply-side instruments heavily dominate South Africa's policy mix. South Africa's goal of improving competitiveness within the manufacturing industry drives this supply-side focus. South Africa's policy also uses population-targeted instruments, and favours the use of generic rather than sector or technology-targeted instruments.

The three main departments that manage South Africa's policy mix are the DST, the dti and the DHET. The policy mix for each of these departments is configured differently. This is because each department has different goals. The DST and DHET focuses on improving the country's science and technology base, while the dti is primarily concerned with the commercialisation of R&D efforts. The policy mix for the dti is therefore configured to achieve this, with more financial, sector or technology-targeted and generic rather than population-targeted

instruments. The issue that arises from this is whether the instruments from the dti are effective in taking the R&D outputs from the DST and the DHET towards a commercial market.

Comparator countries' policy mix was examined with the intent of learning from them to formulate innovation policy for South Africa. India has goals of increasing inclusiveness within the NSI, and therefore created a policy mix that was non-financial, non-competitive and generic rather than population targeted. Demand side measures formed a significant portion of India's policy mix. Canada has prioritised entrepreneurial growth and strengthening the country's R&D base. More supply-side measures together with generic instruments are therefore used by Canada.

7.2.2 Research Question 2 – Country Comparisons

Supply-side measures appear to be favoured by all three countries, but India seems to be the only country that has some demand-side instruments in the policy mix. India has the goal of stimulating the market and creating a favourable environment for innovation, and has therefore adopted a set of demand-side measures to complement their supply-side measures. Canada has a bigger focus on STI and growing R&D. Despite this focus, Canada employs some demand-side measures. A key learning from the comparative analysis is that supply-side and demand-side policies should be used in combination with each other.

7.2.3 Research Question 3 – Policy Effectiveness

This study found that in general the innovation policy instruments are effective on their own, but are not effective in taking products through from the R&D phase through to design and development. A chasm exists between the initial R&D, and eventually taking a product to market. This is because different government departments manage the different policy instruments intended for the different phases of product development. In general it was found that policy instruments are very effective for the early R&D phases of product development, but instruments that support taking that product to a market and developing that market are lacking.

Despite the intent of policy, poor governance reduces the effectiveness of policy. A lack of industry awareness and knowledge of how the different policy instruments are intended to work together compounds this problem.

7.2.4 Research Question 4 – Future Innovation Policy Mix

The choice of innovation policy instruments is determined by considering the goals of a country, as well as the current economic and technological positioning of the country. South Africa has the goals of addressing its socio-economic challenges. At the same time South Africa intends transforming towards a knowledge economy. Taking these goals into account in conjunction with the previous research questions implies that South Africa needs to move the balance of its policy mix towards using some demand side instruments.

South Africa needs to improve the coordination between the DST and the dti. This would help ensure that a basket of complimentary instruments are available for industry to apply through different phases of the product development cycle.

Overall, this study found that South Africa needs to rebalance the innovation policy mix towards using more demand-side instruments and more generic rather than population targeted instruments.

7.3 Recommendations

7.3.1 Recommendations for Policymakers

The following recommendations to policymakers are made based on the findings in this study:

- There is a need to introduce policy instruments that create a positive environment for industry to innovate. The balance needs to shift towards using a combination of supply-side and demand-side instruments.

- The knowledge and awareness of how the different policy instruments interact with each other and support different phases of product development needs to be improved. Measures to improve this knowledge within the industry should be put in place.

- There is a need for skills to be built within the industry, and innovation policy instruments to support this needs more prominence. Artisans and other technical skills are in short supply, so these policy instruments should interact with the current instruments and make use of the DUI mode of innovation.

7.3.2 Recommendations for Managers in Industry

The following recommendations are made to managers in industry based on the findings of this study:

- Managers can influence how policy is formulated by contributing towards the development of policy. One participant in the interviews provided an example where this was achieved, and industry needs to do this more often in other innovation policy areas.

- A greater knowledge of policy and how the various instruments interact with each other is essential in order to effectively apply the available innovation policy instruments. Managers in industry need to familiarise themselves with the portfolio of policy instruments on offer by the various government departments and work out how to effectively combine them to achieve their goals.

7.4 Limitations

This study evaluated innovation policy mix and its effect on a sector by considering already established companies. Innovation can stem from entrepreneurial activity (J. A. Schumpeter & Opie, 1934), and this research does not cover that. The use of innovation policy instruments to stimulate entrepreneurial activity within a sector was not included as a part of this study.

This study focussed on a single sector of the economy. The study used national spending as the basis for charactering innovation policy mix, and there is a challenge in identifying precisely what was spent within a particular sector. This means that the innovation policy mix that is presented in this study is a best approximation. Such an approximation is adequate for the purposes of this study.

7.5 Future Research

This study used a qualitative approach towards defining future innovation policy. Based on these finding, it could be useful to perform a quantitative study to determine what the actual expenditure on each category should be.

This study focussed on the manufacturing sector. Future research could characterise the innovation policy in other sectors of the economy. There is an increasing focus on renewable energy and green technologies, and future research could evaluate the innovation policy mix in

those or other emerging sectors. This would help researchers and policymakers understand the impact of policy on developing new capabilities.

This study used only two comparator countries. Future research could take learning from other OECD countries into account.

7.6 Conclusion

The primary goal of this study was to examine how South Africa's innovation policy mix could be rebalanced to improve the outlook for the manufacturing sector. It achieved this goal by first characterising policy mix, then comparing with other countries before evaluating the effectiveness of policy mix, and finally applying these results to propose a rebalancing of the policy mix.

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Appendix A: The Interview Guide

Interview Guide

Introduction (5 Mins)

This study aims to characterise and evaluate South Africa's innovation policy mix within the manufacturing sector of the economy. This characterisation will then be applied to identify areas for improvement and hence increase the prospects for the sector in terms of its contribution to economic growth. The title of this research project is: "*Rebalancing Innovation Policy Mix to Improve Support for South Africa's Manufacturing Sector*".

Governments apply a mixture of public policy instruments to influence behaviour of the actors within a National System of Innovation. Public policy instruments may be defined as a set of techniques by which governmental authorities wield their influence in attempting to ensure economic support and effect societal change and innovation policy mix is implemented through such a set of policy instruments (Borrás & Edquist, 2013).

Some examples of instruments used within South Africa are: Automotive Investment Scheme (AIS), Critical Projects Feasibility Programme (CPFP), Production Incentive (PI), Manufacturing Competitiveness Enhancement Programme (MCEP), R&D Tax Allowance Incentives, etc. There may be other examples of policy instruments that your organisation may use, and we would like to find out more about that.

Question 1 (2 Mins)

(a) What sector of the economy does your organisation fall under?
(b) What is your position within the organisation?
(c) How many years have you worked in this organisation?

Question 2 (5 Mins)

(a) Does your organisation make use of any of the innovation policy instruments that the South African Government offers?
(b) If so which one do you make use of?

Question 3 (10 Mins)

(a) How effective have these instruments been for your organisation?
(b) Which of the policy instruments that you have used have had the biggest impact on your organisation?

Note: Effective = Benefit > Cost; AND Benefit > 0

Impact = effective or ineffective change.

Question 4 (20 Mins)

How would you change the current innovation policy to be more effective for:

(a) Your organisation?
(b) The Manufacturing sector in South Africa generally?

List of Policy Instruments

Policy Instrument	Description
Automotive Incentive Scheme (AIS)	The AIS is an incentive designed to grow and develop the automotive sector through investment in new and/ or replacement models and components that will increase plant production volumes, sustain employment and/ or strengthen the automotive value chain.
Capital Projects Feasibility Programme (CPFP)	The CPFP is a cost-sharing grant that contributes to the cost of feasibility studies likely to lead to projects that will increase local exports and stimulate the market for South African capital goods and services.
Clothing and Textile Competitiveness Improvement Programme (CTICIP)	The programme aims to build capacity among clothing and textile manufacturers and in other areas of the apparel value chain in South Africa to enable them to effectively supply their customers and compete on a global scale, encompassing issues of cost, qulaity, flexibility, reliability, adaptability, and capability to innovate.
Production Incentive	A sectoral incentive designed to assist industry in upgrading its processes, products and people.
Critical infrastructure Programme (CIP)	The CIP aims to leverage investment by supporting infrastructure that is deemed to be critical, thus lowering the cost of doing business. The South African Government is implementing the CIP to stimulate investment growth in line with the National Industrial Policy Framework (NIPF) and Industrial Policy Action Plan (IPAP).
Manufacturing Competitiveness Enhancement Programme (MCEP)	The MCEP aims to encourage enterprises to upgrade their production facilities, processes, products, upskill workers and to provide for the upgrading of sectors to maximise output and employment.
People-Carrier Automotive Incentive Scheme (P-AIS)	P-AIS is a sub-component of the Automotive Incentive Scheme (AIS) and provides a non-taxable cash grant of between 20% and 35% of the value of qualifying investment in productive assets with the objective of stimulating a growth path for the people carrier vehicles industry through investment in new and/or replacement models and components that will result in new or retention of employment and/or strengthen the automotive vehicles value chain.
Section 12I Tax Allowance Incentive (12I)	The 12I Tax Incentive is designed to support Greenfield investments (i.e. new industrial projects that utilise only new and unused manufacturing assets), as well as Brownfield investments (i.e. expansions or upgrades of existing industrial projects). The incentive offers support for both capital investment and training.

Policy Instrument	Description
Support Programme for Industrial Innovation (SPII)	The SPII is designed to promote technology development in South Africa's industry, through the provision of financial assistance for the development of innovative products and/or processes. SPII is focussed specifically on the development phase, which begins at the conclusion of basic research and ends at the point when a pre-production prototype has been produced.
Black Business Supplier Development Programme (BBSDP)	The BBSDP is a cost-sharing grant offered to small black-owned enterprises to assist them to improve their competitiveness and sustainability. The programme provides grants to a maximum of R1 million (R800 000 for tools, machinery and equipment and R200 000 for business development and training interventions per eligible enterprise to improve their corporate governance, management, marketing, productivity and use of modern technology).
Technology and Human Resources for Industry Programme (THRIP)	THRIP is a partnership programme funded by the Department of Trade and Industry (the dti) and managed by the National Research Foundation (NRF). On a cost-sharing basis with industry, THRIP supports science, engineering and technology research collaborations focused on addressing the technology needs of participating firms and encouraging the development and mobility of research personnel and students among participating organisations.
Small Enterprise Development Agency: Technology Programme	The seda Technology Programme (Stp) is a division of seda (Small Enterprise Development Agency) focusing on technology business incubation, quality & standards and technology transfer services & support to small enterprises.
Export Marketing and Investment Assistance (EMIA)	The EMIA scheme develops export markets for South African products and services and to recruit new foreign direct investment into the country.
Sector-Specific Assistance Scheme (SSAS)	The Sector Specific Assistance Scheme is a reimbursable cost-sharing incentive scheme whereby financial support is granted to organisations supporting the development of industry sectors and those contributing to the growth of South African exports.

Appendix B: Informed Consent Letter

Informed Consent Letter

Dear Participant

I am conducting research on innovation policy mix in South Africa as part of my Masters in Business Administration (MBA) studies at Gordon Institute of Business Science (GIBS). This research aims to find out how effective South Africa's approach towards innovation policy has been in addressing economic growth within the manufacturing sector, and how future innovation policy mix should be configured in order to improve the outlook for the manufacturing sector. I request the opportunity to interview you regarding this topic.

Our interview is expected to last no more than 45 minutes, and will help us understand how to reconfigure South Africa's innovation policy mix to influence economic change through effective policymaking.

Your participation is voluntary and you can withdraw at any time without penalty. All data will be kept confidential, and aggregated for subsequent analysis. Should you be interested, a copy of the interview transcript and final research report can be made available to you. If you have any concerns or reservations, please do not hesitate to contact my supervisor, Prof David Walwyn, or me. Our details are listed below.

	RESEACHER	SUPERVISOR
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_____ _____

Signature of Participant Date

_____ _____

Signature of Researcher Date

Appendix C: Consent for Audio Recording

Consent for Audio Recording

This study involves the audio recording of your interview. Neither your name nor any other identifying information will be associated with the audio recording or the transcript.

Transcripts of your interview may be reproduced in whole or in part for use in this study. Neither your name nor any other identifying information (such as your voice or picture) will be used in any output resulting from the study.

By signing this form, I am allowing the researcher to audio-record this interview as part of this research.

_____ _____

Signature of Participant Date