UNIVERSITY OF KWAZULU-NATAL

DETERMINANTS OF COMMERCIALIZATION OF TECHNOLOGICAL INNOVATIONS IN DEVELOPING ECONOMIES: A STUDY OF ZIMBABWE'S RESEARCH INSTITUTES

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A thesis submitted in partial fulfilment of the requirements for the degree of

Doctor of Philosophy

School of Management, IT and Governance
College of Law and Management Studies

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2014

DECLARATION

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ACKNOWLEDGEMENTS

The accomplishment of this write-up was a result of various individuals having to sacrifice in one way or the other. The researcher acknowledges the following for without their assistance, the thesis would not have been completed:

- Firstly and foremost, Glory to God the Father, the Son and the Holy Spirit for without His guidance there could be nothing to talk about.
- My supervisor, Dr. Maxwell A. Phiri, for his professional guidance and encouragement throughout the research journey, for standing with me through thick and thin, for facilitating the financial support I needed through the study, for supporting me all the way through various international conferences and the publications journey – all is most appreciated.
- Prof. Chitakunye, for partly acting as a co-supervisor to the study, for the insights shared and for teaching me the secret to success in the academia – *"publish or perish"*. Whatever you are going through, may God sail you through.
- My wife and our lovely family for encouragement and moral support – I will make efforts to compensate the loss of attention during the period of the study. "Dr." Hope Nokutenda, you are the main reason for this hard work!
- Debbie Cunynghame and Christel Haddon, for their outstanding administrative support that went a long way in facilitating the success of my thesis.
- Bruce T. Mawire, for assistance with the study's statistical analyses and interpretations.
- Colleagues, friends and relatives for their encouragement and support throughout the study.
- All research institutes and respondents who consented to participate in this study, for the sacrifices they made in taking their time in responding to the research questions.

ABSTRACT

While preceding studies on innovation management have expressed satisfaction in innovation creation by research institutes worldwide, the commercialization of these technological innovations (TIs) remains a major challenge in most developing economies such as Zimbabwe. Despite the numerous and creditable innovations developed to date, Zimbabwe is yet to benefit from the full commercialization of these research outcomes. The main aim of this thesis was to establish the determinants of commercialization of innovations in Zimbabwe's research institutes.

Guided by the study's objectives, theoretical constructs were drawn from extant literature on commercialization enabling factors, inter-firm commercialization partnerships and market-based factors, and these were key inputs in designing the study's framework for both quantitative and qualitative investigation. The study utilized mixed research methods, based on the integrative nature of the study's research design and philosophy. Multiple data collection sources were used, inclusive of literary analysis, self-administered questionnaires for customers (260), for research institutes' staff (94) and key informant interviews with both private and public research institutes (6).

The study found that successful commercialization of a new product is influenced by perceptions that consumers hold of it, correct application of launch decisions and the level of customer involvement. Although it emerged that Zimbabwe's technological innovations are perceived to be meeting customer expectations, the study revealed that successful commercialization is being hindered by financial constraints, lack of proper commercialization infrastructure, limited consumer access to new products, poor sectoral support, patents mal-administration, and long time lags between new product development and market introduction, among other hindrances. Using the Principal Component Analysis technique, it emerged that there are numerous essential predictors of successful commercialization including test marketing, feedback use, product accessibility and sectoral support in the form of Public-Private-Partnerships (PPPs).

The study's findings have obvious important repercussions for re-shaping public policy. The researcher recommends approaches through which research institutes and policy makers can unlock value in commercializing Zimbabwe's technological innovations essentially in form of revitalizing the Commercialization Fund, making efficient use of PPPs and improving consumer communications and access to new products. Future studies could focus on developing a framework which developing economies can adopt in creating a platform for PPPs, responsibility or role distribution, management issues as well as "best practices" for running PPPs.

Keywords: commercialization, developing economies, PPPs, Technological Innovations, Zimbabwe

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LIST OF ABBREVIATIONS AND ACCRONYMS

CF	Commercialization Fund
COO	Country of Origin
CRD	Commercialization of Research Department
GNU	Government of National Unity
HRS	Henderson Research Station
ICF	Innovation and Commercialization Fund
M	Mean
MSTD	Ministry of Science and Technology Development
NP	New Product
NPD	New Product Development
PPPs	Public-Private-Partnerships
R & D	Research and Development
R & D-C	Research and Development – and Commercialization
RCZ	Research Council of Zimbabwe
S & T	Science and Technology
SD	Standard Deviation
SIRDC	Scientific and Industrial Research Centre
SPSS	Statistical Package for Social Sciences
TC	Technology Commercialization
TIs	Technological Innovations
UK	United Kingdom
UKZN	University of KwaZulu-Natal
USA	United States of America
WIPO	World Inventions Patents Organization

CHAPTER 1

GENERAL INTRODUCTION TO THE THESIS

1.1 INTRODUCTION

"It's easy to come up with new ideas; the hard part is letting go of what worked for you two years ago, but will soon be out of date." — Roger von Oech

Modern technological innovations play a major role in alleviating problems experienced by the societies we live in. Innovation can drive economies even in times of crises (Hausman & Johnston, 2014). It is also the rate at which such innovations are created and availed to the market that plays a major role in graduating developing nations into developed economies. While research shows that there is not much deficiency in innovation creation in institutions of research (Mowery, Nelson, Sampat & Ziedonis, 2001), commercialization of these innovations remains a major challenge in most developing economies (Chandran, Farha & Veera, 2008). In fact, empirical evidence shows that new technological innovations commercialization have had significant failure rates of up to 50% throughout the world (Cierpicki, Wright & Sharp, 2000) and indeed, this trend has not changed much over the past two centuries. Through it all, Zimbabwe is not spared. There remains a rampant debate in the sphere of commercialization of technological innovations as to whether lack of technological innovations' commercialization is a result of lack of market-driven technological innovations that are worthwhile to warrant commercializing or whether it is a case of innovations failing to make an impact and / or impression by being uncompetitive relative to existing technologies?

1.2 BACKGROUND TO THE STUDY

The role of commercialization of technological breakthroughs has been identified as a key component in stimulating economic development (Zairi & Naeem, 2005; Avdeitchikova & Coenen, 2004; Wyles, 2001). When Zimbabwe became independent in 1980, the then government invested significant resources in the formation of various research institutes. One such institution was the Scientific and Industrial Research Centre (SIRDC), created in 1993 through the provisions of the *Research Act of 1986*. Besides SIRDC, various other research institutes have been established, including the Kutsaga Research Institute, Agricultural Research Technology (ART) Farm, Institute of Agricultural Engineering (IAE), University of Zimbabwe and other national universities' research institutes, polytechnic colleges, and the Henderson Research Station (HRS), including many others. Most, if not all, of these institutes have made various technological breakthroughs which have been either inadequately or never commercialized at all.

Commercialization is a major component in unlocking value from technological innovation (Chandran *et al*., 2008), hence its role can never be over-emphasized. However, both public and private research institutions in developing countries often develop cutting edge technology only to see the results locked up and inaccessible to businesses and citizens who could benefit from the research. Based on the realization that sound economic development can only be fostered from these research centres, support was rendered to them with overall expectations being that commercial outcomes would be realized from these institutes and that the research discoveries would be brought to the global market. However, an incongruity exists. Despite strength and quality of research outcomes from the various centres of research, very little has been realized in terms of ideas graduating from the laboratory to the market. Based on this background, the researcher sought to explore the hindrances and barriers to successful commercialization of Zimbabwe's research outcomes. The research was motivated by the apparent lack of translation of innovative research results to profit.

1.2.1 Commercialization of Technological Innovations in Zimbabwe: The Status *quo*

The status of commercialization of research outcomes in Zimbabwe is disappointing. The Minister of Science and Technology Development once declared:

> *"…the Ministry has the task of facilitating commercialization of R & D outcomes...we can produce a lot more convincing work if our research is commercialized...there are few examples of (developing) countries that are successfully commercializing research and we need more examples of this…"* (Ministry of Science and Technology Development, 2009: 5)

Kwaramba (2009) asserts that while Zimbabwe has scores of colleges, technical colleges as well as technological centres, the conversion (graduation) of ideas into valuable businesses remains limited. Additionally, the Ministry of Science and Technology Development notes that R & D results' commercialization is still at grassroots levels.

Rare talent is found in personalities from the private sector, such as Daniel Chingoma (of Taisek Engineering) who invented the uniquely shaped and engineered "Zimcopter" and varying models of hand-operated water pumps; Millicent Mupure who invented the handbag cell phone and won the WIPO Gold Medal for the Best Woman Inventor category award in 2004, while Charlesly Brian Roy won a similar award for inventing "instant tea maker" (WIPO, 2004). The flawed market introduction, and low uptake of bio fuels such as ethanol fuel (E10) in Zimbabwe, leaves a broad area which guarantees further studies to complement the few papers presented and published thus far (*e.g.* Chitakunye, Saruchera, Derera & Tarkhar-Lail, 2014; Saruchera, Phiri & Chitakunye, 2014;

Saruchera & Chitakunye, 2013). Several other innovations, by different indigenous research institutions and/or individuals, have remain in the bud, including the Gravity Mill, Solar Cooker/Dryer, Micro-concrete (roofing) tiles, varieties of mushroom, and the *Gwatamatic* machine, to mention just a few.

Thus it is clear that there is a serious gap between the generation of research outcomes and the commercialization of these research outcomes. This study therefore focuses on the challenges faced by Zimbabwe's research institutes in their attempt to realize commercialization success from their research and development efforts, and how such challenges can be overcome.

1.3 RESEARCH PROBLEM

The identification of determinants which lead to successful commercialization of technological innovations in developing countries can lead to the creation of sustainable economies in most third world African countries such as Zimbabwe. Despite the numerous and laudable achievements made in the area of research, as outlined in the background to the study, Zimbabwe is yet to enjoy the benefits of seeing these research outcomes being commercialized. The hindrances to the successful commercialization of these research outcomes have remained unclear. If the outcomes are getting to the market, it has also remained unclear if the technological innovations address the specific market needs and expectations.

Although some studies have been carried out elsewhere, the researcher is very confident that research institutes active in a developing economy such as Zimbabwe have been waiting for research similar to this, as a lasting solution to their dilemma of having to create, invent ideas, concepts, prototypes and products without enjoying the fruits thereof. In fact, much previous work has concentrated mainly on commercialization issues in developed and emerging economies (*e.g.* Anokhin, Wincent & Frishammar, 2011; Kim, Lee, Park & Oh, 2011; Antioco & Kleijnen, 2010; Wonglimpiyarat, 2010; Corkindale, 2008; Pellikka & Lauronen, 2007; Pellikka & Virtanen, 2003; Andrew & Sirkin, 2003; Jolly, 1997) whereas only a few studies have focused on developing economies (*e.g.* Chandran, 2010). The few studies that have been carried out focus primarily on the barriers of commercialization. Much work sought to understand the factors that explain the challenges faced by research institutes in developing economies in commercializing their technological innovations; and literature on PPPs in developing economies seemed to be lagging behind. The literature has been primarily limited with regards to 'how', i.e. defining commercialization success, and the factors that influence (i.e. facilitators and hindrances) that success (Phan and Siegel, 2006; Shane, 2004). The current study thus incorporates perceptual issues together with the role played by PPPs, over and above establishing the determinants of successful commercialization.

The theory of Public-Private-Partnerships (PPPs) and their increasing applicability, especially in the provision of public facilities and services has commanded some research interest worldwide. However, few attempts have been made to unlock the value in the PPP's capability in enhancing commercialization of technological innovations, worse still from a developing economy's perspective. Thus the study also unlocks the value through exploring the role that PPPs play, particularly in the commercialization of technological innovations.

1.4 OBJECTIVES OF THE STUDY

The main objective of the study was to explore the determinants of commercialization of technological innovations in Zimbabwe's research institutes. The specific objectives were as follows:

- To establish the determinants of successful commercialization of technological innovations in Zimbabwe's research institutes.
- To determine customer perceptions on the state of innovations commercialization in Zimbabwe vis-à-vis their innovation expectations.
- To establish the role of Private-Public Partnerships (PPPs) in the commercialization of technological innovations.
- To develop a roadmap as an intervention tool in policy-making as a way forward based on the research findings.

1.5 RESEARCH QUESTIONS

- What are the determinants of successful commercialization of technological innovations in Zimbabwe's research institutes?
- How do customers perceive Zimbabwe's local innovations vis-à-vis their innovation expectations?
- What role do PPPs play in the commercialization of technological innovations in Zimbabwe?
- Based on the research findings, what could be done to improve the commercialization of technological innovations in Zimbabwe's research institutes?

1.6 CONCEPTUAL FRAMEWORK & RESEARCH HYPOTHESES

Based on the extant literature, the study proposed the following conceptual framework from which several hypotheses were drawn and later tested, in order to explain the relationships between the study's constructs.

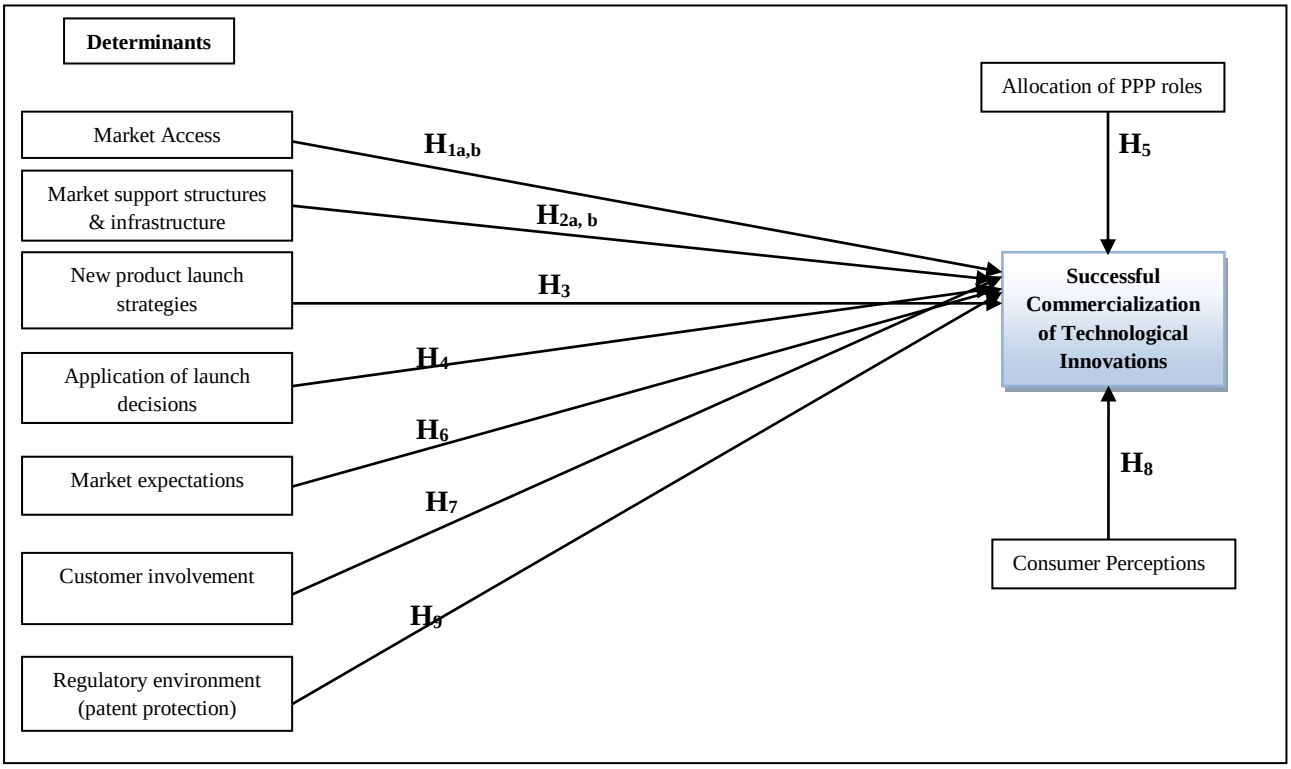

Figure 1.1: The Proposed Conceptual Framework of the study

Source: *Drawn from the extant literature of the study*

Based on the conceptual framework above (Figure 1.1), several hypotheses were proposed for the study, as follows:

H_{1a}: Commercialization success of a technological innovation depends on market access.

H_{1b}: There is an association between the rating of market access and the value placed on the determinant by customers.

H_{2a}: Commercial performance of a new technology is dependent upon market support structures and infrastructure.

H_{2b}: There is a positive association between the extent of failure by government to provide technological infrastructure and the agreement with government giving adequate support for commercialization.

H_3: Successful commercialization of a Technological Innovation (TI) depends on the new product's launch strategies.

H_4: Successful acceptance of a TI depends on the proper implementation of market introduction (launch) decisions (i.e. decisions pertaining to launch timing, targeting and positioning, awareness).

H_5: Commercialization success depends on the appropriate allocation of PPP roles.

H_6: Good acceptance of a new product depends on understanding market expectations.

H_7: Successful commercialization is most likely to be achieved through customer involvement.

H_8: Successful commercialization of a new product depends on the perceptions of consumers or potential consumers hold of it.

H_9: Successful commercialization can be positively influenced by the regulatory environment such as patent protection.

Details regarding the proposed framework as well as the hypotheses are discussed in full in the third chapter (Chapter 3) of this write-up.

1.7 MOTIVATION AND RESEARCH CONTRIBUTION

1.7.1 Market Opportunities

In a technologically dynamic world, recent research shows that the subject of commercialization is becoming an increasingly important phenomenon worthy of additional inquiry – and of increasing interest especially to policymakers. Shane (2004) argues that spinoffs have become standard radical technological developments, especially in knowledge-based sectors. The development and adoption of technological innovations have a tendency of being geographically delimited (Audretsch & Feldman, 1996). Thus with effective commercialization, such boundaries are broken as awareness of the product is created worldwide.

As the consumer generation is slowly changing to *Generation Y*, consumer and buyer behaviour is also set to change. The research further sought to figure out how successful commercialization could be achieved through the invention of technological innovations that would satisfy such *Generation Y* customers who have taken up the total market by storm.

1.7.2 Policy Interest

There is indeed a need for further scholarly research in order to better the understanding of the conditions and policy forces that "encourage and sustain academic entrepreneurship" as put across by Wood (2011), in support of Phan and Siegel (2006). Hart (2003) calls for the need for further research on "successful commercialization". Most developing economies, including Zimbabwe, are seeking ways, during these tough and uncertain financial times, to promote activities that create employment. It is convincible that R & D holds the promise. However, such promise may only materialize if the TIs find their rightful place on the market through effective commercialization. Thus this study also provides policymakers with ways to encourage and support R & D and commercialization, which has been the missing link.

It is quite unfortunate that, due to ungoverned relationships with research institutes' structures and systems and the embryonic nature of the literature on the phenomenon, policymakers seem not to fully understand how research institutes are governed, their operational norms (culture), as well as the concept of "academic entrepreneurship", and its relationship to public policy and programs (Wood, 2011; National Governors Association, 2007; Hart, 2003). Hence, a lack of a clear appreciation of this issue may indeed result in policies that either do not best support commercialization; or could result in policy and programs that depress or deteriorate the efforts of private and public research institutes, as well as upcoming academic entrepreneurs. This research thus also sought to provide findings relevant to policymakers at numerous levels of government and both private and public research institutes. The study was anticipated to offer an important reference to formulate Science and Technology (S & T) policies for technology development, transfer and commercialization by analyzing the determinants of the successful technology commercialization in developing nations.

1.7.3 Economic Development Interest

Among other developing African countries, Zimbabwe has largely been a net importer of most technologies, and this has significantly, negatively impacted the balance of payment of the country. Thus, unless and until the country is able to commercialize the fruits of its R & D efforts, meaningful economic development will be difficult to achieve. The policy of technology transfer from developed nations has proven that it has failed to bring out intended benefits, especially in a country stumbling under the effects of sanctions. As propounded by Petti and Zhang (2011), in support of Liu (2008), the fight towards technology catch-up has indeed taken centre stage; thus any developing country that entertains hopes of fully transforming its economy can do so only by introducing their local cutting edge technology solutions.

1.7.4 Framework for Sustainable PPPs' Development & Management

The study unearthed the power of PPPs in research commercialization through exploring the role that such partnerships play and their effects on economic growth. The study then provided a literary framework which developing economies can adopt to assist in creating a platform for PPPs, responsibility and role distribution.

1.8 RESEARCH APPROACH

Since the research paradigm was integrated, the researcher used a combination of strategies. Qualitative methods in the form of case studies were used so as to create an "in-depth" and "rich account" (Yin, 2003: 95; Rubin & Rubin, 1995: 107) of how research institutes commercialize their innovations and what the market thinks or perceives about the institutes' efforts. Having established

this knowledge, the second stage involved the determination of the factors facilitating and those hindering the efforts of the research institutes through carrying out a survey.

1.9 LIMITATIONS

Difficulties in obtaining information on some aspects of commercialization were encountered mainly because the information was considered to be classified; particularly in public sector institutes (for example, information on policy related issues). There was also limited and scattered historical information on the commercialization of technological innovation and seemingly few studies have been carried out to investigate the impeding factors on commercialization of technological innovations. This limitation, however, provided a prolific foundation on which to build the study, as well as a gap which the present study would fill. Time and financial constraints limited the present study to focus on a single developing economy only - Zimbabwe. This means that the generalization of the study's findings might be limited to the country under study only. In order to counter this limitation, the present study can be considered exploratory which means that it needs to be exposed to further confirmatory studies, thus this limitation also presents a gap that can possibly be filled through future studies.

1.10 SCOPE OF THE STUDY

The study sought to establish the determinants of successful commercialization of technological innovations from a developing economy's perspective, with reference to Zimbabwe's research institutes. The study's scope falls within management and marketing fields, but more specifically focuses on innovation management. The key variables of this study include commercialization, consumer perceptions, new products, and the role of PPPs in commercialization of technological innovations.

The study was carried out between August 2012 and September 2014 in Zimbabwe. It was limited to commercialization of technological innovations at research institutes across all sectors excluding the health sector, which was specifically excluded due to the need for additional and lengthy clearance processes with the relevant ministries and medical authorities. Respondents targeted included institute directors, staff at these different research institutes as well as the institutes' current and potential customers. The study was carried out in both public and private research institutes within the boundaries of Zimbabwe.

1.11 KEY ASSUMPTIONS

The following assumptions were made in guiding the study:

- ✓ Respondents would volunteer information in truth and sincerity.
- ✓ Respondents would have time to complete all questionnaire and interview questions.
- ✓ Respondents would not challenge the format and content of the research instruments.
- ✓ The information gathered from all those who were approached would be sufficient to draw up comprehensive and generalizable research conclusions that could be applied in any developing nation, especially in Africa.
- ✓ The economic environment under which the study was undertaken would remain constant through the research period.

1.12 DISSERTATION STRUCTURE

The subsequent chapters tackle the research questions through a procedural scholarly inquiry. Thus this write-up is structured as follows:

1.12.1 Chapter 2: Literature Review

This chapter presents a comprehensive review of prior research on the commercialization of innovations. *"Successful"* commercialization is operationalized vis-à-vis its facilitators and inhibitors. Literature on consumer perceptions is addressed in the chapter in view of the third objective of this study. The chapter further explores literature on PPPs and their role in commercialization. It also explores literature on how to create a platform for PPPs, role distribution, management issues as well as giving a literary hint on the "best practices" for running PPP's. Gaps in prior literature are established and the current research endeavors to fill in such gaps, while adding value to the Body of Knowledge.

1.12.2 Chapter 3: Theoretical & Conceptual Framework

This chapter probes the theories underpinning commercialization; including the widely pronounced Stage Gate Model. A review of the existing literature and empirical studies mounts up to the development of a theoretical framework / model. This section explains how the model works and proposes various hypotheses meant to test the workability of the model.

1.12.3 Chapter 4: Research and Commercialization Policy in Zimbabwe

This chapter explores the role of the government in commercializing TIs and traces how far Zimbabwe has gone as far as TI development and commercialization policy is concerned. Based on

policy documentation of technological commercialization, the chapter further pin points the weaknesses and / or gaps in the policy.

1.12.4 Chapter 5: Research Methodology

This chapter outlines how the study was carried out i.e. the research design used, research population, sampling method and procedures, data collection instruments and procedures. It addresses how mixed methodology (Takhar & Chitakunye, 2012) was used and its relevance in this type of study. The section also addresses the issues of data validity, reliability, replication and generalizability.

1.12.5 Chapter 6: Presentation and Analysis of Results

This section reports results, presents data, describes the study's conceptual framework, defines historical analysis, explains and analyzes the main research findings. Data is presented in two phases: the first phase presents qualitative data collected mainly through interviews, whilst the second phase is mostly quantitative, designed to empirically test the findings presented in the first phase among a larger sample of research institutes' staff and customers.

1.12.6 Chapter 7: Discussion of Results

This chapter provides a discussion of the study's findings based on the study's research questions and hypotheses. The discussion of the findings is done through interpreting the results, and explaining the implications of the study's key findings while relating the findings to the existing literature on commercialization of technological innovations. The discussion chapter also takes cognizance of the study's shortcomings i.e. the potential weaknesses of the study in attempting to express the meaning of the study's findings.

1.12.7 Chapter 8: Conclusions and Recommendations

In this chapter, major findings are emphasized upon which conclusions are drawn, supported by data while recommendations and suggestions for further research are proposed based on the conclusions made by the study.

1.13 CHAPTER SUMMARY

The chapter gave an overview of the study. It depicted the background leading to the study and the statement of the problem. It also presented the research objectives, research questions, the conceptual framework and proposed hypotheses for the study. The chapter expressed the motivation of the study and also gave a synopsis of the research approach used by the researcher. The study's limitations, scope of the study, assumptions and the overall structure of the thesis were also presented. The ensuing chapter focuses on the literature review.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The purpose of this chapter is to consider the different views and readings behind the problem under study, that is, the chapter tackles issues relating to key determinants of successful commercialization of innovations, challenges in commercializing innovations as well as a review of some empirical evidence on barriers to commercialization of technological innovations. The literature review culminates by considering recommendations on how to move towards an entrepreneurial research institute, which builds up the basis for literature on Public-Private-Partnerships (PPPs), covered late in this chapter. These two constructs thus serve to identify the theoretical basis of the study.

The history of innovation has been largely centered on Drucker (1986: 779) who defines innovation as: "the systematic act of turning 'something' (product, idea, information, technology, etc) into resource that is of high value to its target market". In support of this inaugural view, Amabile (1988) and Amabile *et al.* (1996: 1154) argue that all innovations begin with creative ideas and thus define innovation as: "the successful implementation of creative ideas within an organization". Amabile *et al.* (1996) view "individuals and teams" as the genesis of all creativity and innovation. The authors further note that 'individuals' are a pre-requisite for the efficient creativity and innovation of 'teams'. Swann (2009) then notes that two things are essential for successful innovation. He claims that it is not just about the generation of new ideas but also about their commercial exploitation.

Nonetheless, Smith and Pech (2006) note that although scientists are indeed good at coming up with excellent technological innovations, both the scientists and their research institutes are usually under-equipped with the necessary skill to convert the innovations into market value. One of the least understood areas of technological innovation commercialization and diffusion has remained the non-adoption of new technology (Selwyn, 2003). The development of 'good' products does not guarantee their marketability. Research reveals that in some cases the intended markets abstain from the functionality of technology, regardless of when it was developed (MacVaugh & Schiavone, 2010; Bruland, 1995).

2.2 INVENTIONS OR INNOVATIONS?

The theoretical discuss of inventions and innovations backdates to the early 1930's with Schumpeter's (1934) proposition that an invention is an idea made manifest while innovations are ideas applied successfully in practice. Schumpeter (1934: 66; 1950) further declares that; "the introduction of a new product or service to the market is a process that begins with an invention, proceeds with the development of the invention, and results in the introduction of a new product, process or service to the marketplace". The Austrian pioneered the subject of innovation management and made inaugural strides after studying how the capitalist system was affected by market innovations. As noted previously, much developmental credit has however been centered on Drucker (1986) especially for his timeless contributions in forms and sources of innovation and innovation management principles.

Subsequent contributions have all been dubbed upon these landmark theorists. For instance, Harris and Robinson (2002) refer to innovation that is inclusive of both "technological" and "organizational" elements as being a "broad definition of innovation including not only the 'hard' technologically determined definition but also the organizational and management practices". In an extensive view, Zairi (1994: 27) states: "what makes an innovation challenging is the fact that it is very difficult to agree on a common ground and to decide which firms are most innovative and how to quantify innovation activity..." In a similar vein, Tushman and Anderson (1986), riding on Drucker (1986)'s contributions, refer to innovation as the creation of products, services or processes, new to a business.

Rogers (1995; 2003) views innovation as an idea, a practice, or an object that is generally perceived as new by an individual or other unit of adoption. Innovation thus implies that the knowledge or idea may not necessarily be new, but could be a modification, improvement or expansion of the existing knowledge base. To clarify this viewpoint, DTI (2007: *Occasional Paper No. 9*) expresses innovation as "a process of continuous renewal involving the whole company and technological developments; it is an essential part of business strategy and every day practice".

In its simplest formulation innovation can be thought of as consisting of research, development, demonstration and deployment – commonly referred to as the Technology Development Cycle (PMET, 2004). Similarly, based on Porter's (1990) strategy formulation concept, technological innovation in Public Research Institutes (PRIs) can be categorized into three groups: "technology developers, leading technology and technology followers". This form of categorization thus supports the view that innovation can be tackled from both organizational and technological viewpoints (Mosey & Woodcock, 2002). It is, however, interesting to comprehend that while most developed economies possess leading technology, it is developing countries that cultivate technology developers

yet they remain technology followers. To this end, Chetsanga (2004) writes on 'brain drain' in Zimbabwe with its push and pull factors, and the effects thereof.

An analysis of various literature reviews affirms the view that Technological Innovations (TIs) are the resultant effect of environmental dynamism. They do not happen in a fixed environment. TIs are most likely to emerge as a result of an interaction between various internal and external environmental factors. They are not something that just takes place anyhow i.e. they involve a systematic, step-by-step process. Tiwari and Buse (2007) view innovation as a simplified originality process and categorize the process into three phases, as illustrated in Figure 2.1 below. In support of this view, Verworn *et al.* (2008: 114) affirm that the innovation process is constituted of "several systematic steps such as requirement analysis, idea generation, idea evaluation, project planning, product development, product testing, and product marketing". Both Verworn *et al.* (2008) and Tiwari & Buse (2007) agree that these steps overlap with one another, as also illustrated in Figure 2.1.

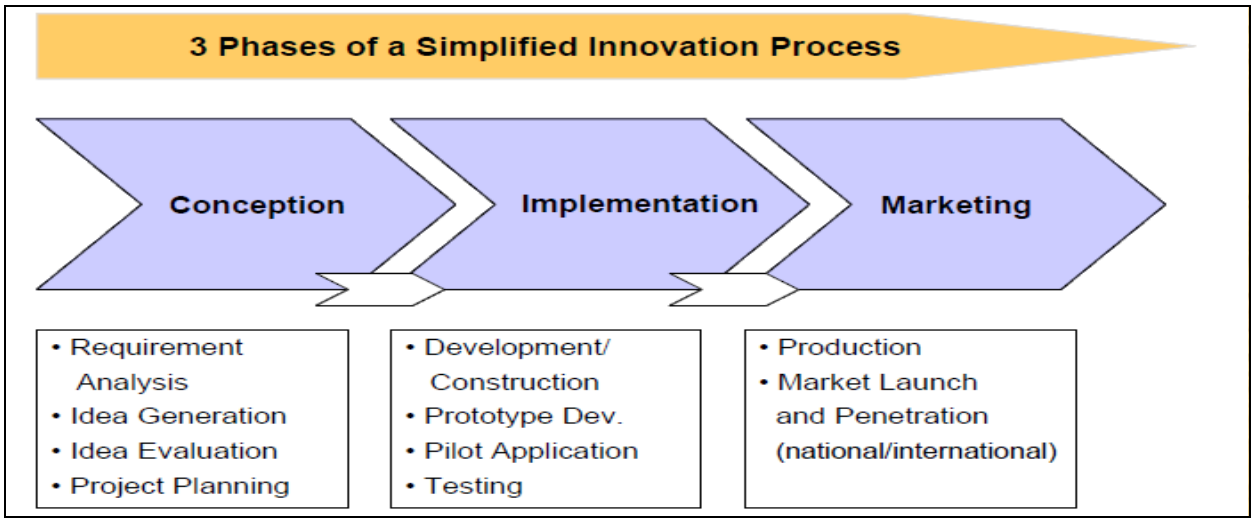

Figure 2.1: Three Phases of a Simplified Innovation Process (Tiwari and Buse, 2007:5)

Although the model is quite intricate to concur on a universally accepted characterization of innovation (Zairi, 1994), from the above propositions and views on inventions and innovations, it can be argued that an "invention" may only become "innovation" when it has passed through the processes of production, marketing and market diffusion. The current study dwells much on determinants of commercialization of technological innovations. The study thus adopts Buse *et al.*'s (2010) and Tiwari and Buse's (2007) views regarding innovation as the process of inventing and commercializing new products, services and processes; or the commercialization of improved existing commodities.

2.3 PERSPECTIVES ON COMMERCIALIZATION OF TECHNOLOGICAL INNOVATIONS (TIs)

The literature on technological innovation commercialization has expanded considerably over the years with much of it being empirical and seeking to find ways to successfully and profitably commercialize research findings (Nekar & Shane, 2003). The Organization for Economic Cooperation and Development (OECD)'s (2003; 1991) studies on TI's attempt to preeminently capture the fundamental nature of technological innovations from a market point of view, as a "process initiated by the perceptions of a new market and/or new service opportunity for a technology based invention which leads to development and marketing tasks striving for the commercial success of the invention." This view of the OECD puts forward two critical issues, firstly, the fact that "the innovation process comprises the technological development of an invention combined with the market introduction (commercialization) of that invention to end-users through adoption and diffusion". Secondly, the view implies that innovation is an "iterative" process meaning that i.e.it goes forth and back – there is a likelihood of new product introduction and re-introduction or re-launch of improved versions of the new product. Based on these findings, Rosenau (2001) notes that such an iterative process of innovation implies diverging levels of innovativeness. This thus calls for the need to relate the varying innovation types (Rosenau, 2001).

Mitchell and Singh (1996:170) envision and define commercialization as "…the process of acquiring ideas, augmenting them with complementary knowledge, developing and manufacturing saleable goods, and selling the goods in a market." Other authors tend to differ from the view that commercialization starts with idea acquisition. In fact, in several cases, commercialization is perceived to exist after the prototype has been made and about to be launched.

For instance, Jolly (1997) relates commercialization as rather the introduction of, or offering a new product to the market. He further asserts that technological innovation commercialization is the process through which technologies are developed and brought into widespread use. However, Zahra and Nielsen (2002: 377) tend to slightly differ. They view commercialization as "a process, which begins with product conception; proceeds to product definition, design, prototyping and pretesting stages; and is consummated by effective product manufacturing and marketing". Based on these contributions, Avdeitchikova & Coenen (2013: No. 2013/6; 2004) find that commercialization links what they term "a technological discovery" to available market opportunities. The duo further associate commercialization with a process that they argue "begins with developing a product that is competitive in terms of technical function and cost in relation to the solutions presently available, and ultimately getting the new product to the market". Courtois (2004) offers a simplified definition when he states that commercialization refers to the introduction of a new product or offering to the market.

These views are supported by Frattini *et al.* (2012), who highlight that technological innovation commercialization is the process through which technologies are developed and brought into widespread use.

Through their longitudinal case study, Mørk *et al.* (2006:446) shed light on the practices of the concepts of construction, enacting as well as packaging innovations. They argue that these three interact and co-exist across time and space and the authors particularly insinuate that "packaging" is "supposed to be a metaphor for the work required for finalizing, commercializing, and what they refer to as '*commodifying'* the innovation".

From the above views it can be noted that commercialization has been defined from various diversified angles. It is, however, important to note that commercialization bridges the gap between product development and the market. For this reason, current research sidelines the simplified views of Jolly (1997) that commercialization is the introduction of, or offering a new product to the market.

2.3.1 Why Commercialize TIs? Why Focus On Commercialization?

Schumpeter's (1934:7) propositions seem to suggest that one important driver of innovation commercialization is "the willingness of the firm to proceed with the development of an invention to transform it into a new product or service for introduction to the marketplace". To this end, Nerkar & Shane (2007:1159) thus put forward that "the willingness of firms to engage in the process of invention commercialization is influenced by expectations about the returns that they will capture from commercialization if they are successful". A product or service that is not well commercialized can easily fail and the expected return on investment could not be achieved. Accordingly it has been widely recognized in economics research that the innovation-related performance of any economy does not simply entail the nation's "basic research capabilities and inventions" as propounded by Smith and Pech (2006) in support of Kropp and Zolin (2005), but it is rather measured by the nation's competences and capabilities in converting the inventions into new products that are of commercial value to the market (Debackere & Veugelers, 2005).

The current study is of the view that a product or service that is not well commercialized can easily fail and the expected return on investment may fail to suffice. Therefore, the idea of institutes engaging in technological invention commercialization based on expected returns might be a poor business decision. In any case, the realization concept should be adopted for new products i.e. due to a host of uncertainties that enfold new products' marketization, any returns should only be accounted for when fully realized, rather than anticipated.

The invention i.e. the creation, discovery or design of a new offering (Kwaramba, 2009) on its own does not direct contribute to the economy. Slater and Mohr (2006:26) boldly claim: "the solution to a basic scientific riddle or the invention of a new 'product' only in a laboratory setting makes no direct economic contribution". It only results in what Slater and Mohr (2006:26) term the *"innovator's dilemma"*. Innovation does not only entail laboratory and basic research. It furthermore includes New Product Development (NPD), sales and marketing, product distribution, service provision and, later on, adaptation and upgrading of the product. Petti and Zhang (2011) weigh in by viewing technological inventions as value creation agents but argue that such value may only be obtained when the innovative ideas are translated into "new products". Accordingly, these new products are launched for the benefit of all involved - the marketing organization (through profits), the investors (through investment returns), the inventors (through appropriate rewards), and the society as a whole. Despite this value creation through new products, Petti & Zhang (2011:7) further clarify undoubtedly that "it is the discovery of technological opportunities and their commercial exploitation that makes the difference". Other recent studies have also regarded commercialization of technology as the key factor for acquiring a competitive edge in technology-based firms, especially (*e.g.* Link & Scott, 2010; Enkel *et al.*, 2009).

In order to survive in today's competitive markets, Cooper (2000) suggests that successful Technology Commercialization (TC) plays a critical role. Many other researchers echo the same view by labeling TC ability as a key driver to the success of any inventing organization or institute (e.g. Zahra & Nielsen, 2002; Eisenhardt & Martin, 2000; Cohen & Levinthal, 1990). Zahra and Nielsen (2002) apparently point out that TC enables the firm to gratify its customers' dynamic needs, which the authors specify as needs related to costliness, quality, speediness as well as the newness attributes of the firm's technological innovations. Institutes which successfully commercialize their research output serve as key promoters of economic growth (Pellikka & Lauronen, 2007).

Thus it can be concluded from these views that the development of new products is commendable, but it is the exploitation of such new products through their commercialization that really matters most.

At national level, commercialization, of mostly agricultural output, has been labeled the cornerstone of economic development for many developing countries (Ha°kansson & Waluszewski, 2001; Brown & Kennedy, 1994) of which Zimbabwe has not been an exception, given that the country relies much on the agricultural sector. Further, Mørk *et al.* (2006) put forward that commercialization implicates the production of productive and useable knowledge compared to production of only academic research. As a result of commercialization of continuous, incremental and spiral technological

innovations, countries such as Japan have managed to advance their position in international competition; a move that Nonaka and Hirotaka (1995) proclaim has remained an enigma.

This view is also in line with Schumpeter's (1934) whose arguments are based on the notion that the introduction of technological innovations to the marketplace disfigures the prevailing market equilibrium through challenging existing market structures and sets into motion, industrial dynamics and development of the economy. Schumpeter views economic development as a process which he divides into three phases. The first phase relates to what Schumpeter calls "technical discovery" of new stuff or new ways of doing things, i.e. invention. In the second stage, "innovation occurs", that is, "the commercialization of a new good or service" emanating from the "technical discoveries". In the third stage, "imitation", Schumpeter (1934:7) states; "it concerns a more general adoption and diffusion of new products or processes to markets".

A report on the commercialization forum hosted by Zimbabwe's Ministry of Science and Technology Development notes that commercialization of research and the development of linkages between companies and research institutions has become a major area of focus. Thus, any country that is in control of its own inventions and technologies will enjoy competitive commercial advantages over those that import products and services from other countries. Scientific research and subsequent commercialization of technological innovation have been viewed as a source of future wealth in many economies (Decter *et al.*, 2007). Additionally, commercialization of internally generated technological innovations will result in a massive departure from consumerism to producers and innovators.

In support of the foregoing views, Kayal (2008:74) views technological innovations as "a source of economic prosperity and competitiveness". A country's ability to achieve economic development depends on the extent to which it is able to bring to market its internally generated technologies. Public research institutions often have restricted access to the support necessary to fully realize maximum benefits from their research efforts since most of them will remain on the shelf. Developing countries in most cases rely on technology from other countries through the process of technology transfer. Additionally, over the years the effectiveness of the policy of technology transfer has come under the spotlight thereby heightening the need to bring to market internal research outcomes and innovations.

Commercialization of technological innovations helps the firm to claim a leadership position within the market (Iansiti, 1995) i.e. highly innovative firms are well known to be market leaders and this position comes along with enhanced market growth, improved profitability and improved

responsiveness to market needs (Day, 1999). Rosenau (2001:278) brings the concept of new product radicalism into commercialization, which he says "signifies the newness or innovativeness of the products being introduced to the market. It enables the company to develop new markets or capture existing market share and thereby achieve growth". Although commercialization calls for heavy investment and is thus deemed to be the most costly phase of the NPD process (Hultink *et al.*, 2000; Benedetto, 1999), the researcher is in support of the views of Garrido-Rubio and Polo-Redondo (2005) that commercialization remains critical as it determines the fate of the lengthy and costly NPD process and thus should be given all the necessary support from within and outside the organization.

Current research agrees with the views of Frattini *et al.* (2012) who note that the launch or commercialization stage of the innovation process seems to be particularly critical in high-technology markets due to volatility, interconnectedness and the proliferation of new technologies. It is, however, disturbing that commercialization, though critical, has been repeatedly the least sound-managed activity in most private and public research institutes.

2.4 KEY DETERMINANTS OF SUCCESSFUL COMMERCIALIZATION OF TIs

Montoya-Weiss and Calantone (1994) *in* Garrido-Rubio and Polo-Redondo (2005) are of the view that most of the determinant factors affecting successful commercialization of technological innovations are "controllable by company management" hence they emanate more from within than from the external environment. The same authors argue for the need for the management team to work towards improving all the NPD stages, with particular emphasis on improving the market introduction (new product launch or commercialization) phase. They are of the opinion that improvement of this key phase will probably increase the success chances of the new offering on the market. However, the researchers do not say much about how such an improvement can be achieved by referring the "how" questions to more detailed NPD literature. Although this idea could be true, it can still be argued that the success of an innovation is also determined by several factors external to the organization, though management plays a pivotal role in both internal and external determinants.

2.4.1 "Successful Commercialization" of TIs Operationalized

Not much has been done to scrutinize how research institutes define *successful commercialization*. In fact, there has not been a common or generally agreed definition of just how successful, *successful commercialization* should be. A few researchers who have attempted to define it have often assumed a variety of 'success' measures and these would normally be used for the purposes of their respective studies.

Commercialization of research output is a quite complicated, diverse and an intricate concept that too requires some complex connections and / or interactions amongst researchers (or inventors), research institutes and the investment sector (Australian Research Commission (ARC), 2000). Commercialization of technological TI's is commonly viewed as a process of converting ideas into market-competent products in order to create some market and / or economic value (Pellikka and Lauronen, 2007; Jolly, 1997). Views on *"successful"* commercialization of TI's are unquestionably multifaceted. For instance, Zahra (1996: 289) refers to *"successful"* commercialization as the "firm's ability to develop and introduce a large number of product and process technologies" while Blair and Hitchens (1998) use productivity measures, such as sales per employee to determine commercialization success. It is all about the firm's creation of new knowledge, which is then commercially exploited through identification of market opportunities (Petti and Zhang, 2011). Zahra (1996) believes that successful commercialization rests upon the firm's aptitude to create radically new products.

However, Stevens *et al.* (1999) tend to differ. They believe that successful commercialization revolves around the firm's skill in expediting the new products' introduction to the market. Various other authors (*e.g.* Rothaermel *et al.*, 2007; Leitch and Harrison, 2005; Shane, 2001*a*) use a basic measure for commercialization (spinoff) success – "whether or not" the institute's innovation "continues to exist". Nerkar and Shane (2007) measure the likelihood of commercialization by the achievement of first sale. Interestingly, various other authors and researchers perceive the concept of *"successful"* commercialization of TI's quite differently, with some deciding to simply calling it "commercialization" rather than *"successful"* commercialization. Based on the fact that this study is anchored on establishing factors affecting the *"successful"* commercialization of TI's, it is necessary that the review focuses on views that attempt to quantify and / or measure the degree of "success" of the commercialization of technological innovations. Table 2.1 below therefore summarizes the above and other views on the different measures of successful commercialization of TIs.

Table 2.1: Summary of Literature on Definitions of Successful Commercialization

Author	**Successful Commercialization Measure (s)**
O'Gorman (2008)	From academic entrepreneurial innovation perspective – how well entrepreneurial activities bolster the academic career through peer recognition and traditional university rewards success
Nerkar and Shane (2007)	Achievement of first sale
Rothaermel *et al.* (2007); Leitch and Harrison (2005); Rothaermel and Thursby (2005); Shane (2004); Shane and Stuart (2002)	Whether or not an innovation continues to exists
Wright *et al.* (2006); Lockett and Wright. (2005); Shane and Stewart (2002), Zucker *et al.* (2002)	Whether or not the invention (spinoff) attract early-stage finance - venture capital funding, in particular
Rothaermel and Thursby (2005); Leitch and Harrison (2005); Shane (2004); Shane and Stuart (2002)	They use a basic measure for spinoff success: whether or not a firm continues to exist
Shane (2004); Goldfarb and Henrekson (2003)	Whether or not the spinoff has an initial public offering
Vohora *et al.* (2004)	Achieved by passing through a series of iterative, non-linear *"critical junctures"*; specific resources and capabilities that must be acquired in order to pass to the subsequent phase
Meyer (2003)	Defined in terms of the prospect to pursue their (academic) agenda through their entrepreneurial activities, not spinoff growth or profits
Zucker *et al.* (2002,1998) in support of Roberts (1991)	Number of patents and scientific papers, index based on average sales growth and projections, length of company existence, and its profitability
Blair and Hitchens (1998)	Uses productivity measures, i.e. sales per employee
Zahra (1996)	The firm's ability to develop and introduce a large number of product and process technologies

Source: ***Extracted from various sources***

For the purposes of this study, the best way is probably to consider these various dimensions concurrently so as to understand the factors that influence commercialization of technological innovations. The researcher is of the opinion that different technological commercialization proportions contributed by different authors all have a unique function to play in enhancing a sustainable competitive advantage for the firm. Thus the firm's commercialization rate dictates its capabilities in introducing new offerings promptly compared to competing firms, and this is especially important in a dynamic environment, which is typical of the twentieth century business environment, in which Zimbabwe's research institutes are also operating.

2.5 DETERMINANTS OF SUCCESSFUL COMMERCIALIZATION OF TI'S

Slater and Mohr (2006:26) ask, "How can market leaders avoid the innovator's dilemma and continually develop disruptive innovations to retain their leadership position?" In order to deal with this question, the authors talk of the need to anchor the firm's technological innovations commercialization on a blend of the organization's strategic and marketing orientations as well as target market selection. Preceding studies have different lines of thoughts. For instance, they argue that successful commercialization performance is determined by an organization's internal and external capabilities (Kang *et al.*, 2011; Teece *et al.*, 1997; McGrath *et al*., 1996; Pennings and Harianto, 1992), "human resource practices" (Nerkar, McGrath & MacMillan, 1996), incentives (Teece, 1986), top management related factors (Howell & Higgins, 1990) and the firm's operating environment (Wade, 1996; Abrahamson & Rosenkopf, 1993). Whilst these research findings shed light on some of the key determinant factors of commercialization of inventions, they have not sufficiently discussed resultant effects of these factors (Tushman & Anderson, 1986). To this end, Nerkar and Shane (2007) empirically examine these technological innovations' attributes and their influence on commercialization – a move that was intended to fill this gap.

Though commercialization is said to be complex, risky and costly (Hultink *et al.*, 2000, 1997), several facilitating factors can be employed to ensure its success. The current research terms these *"commercialization facilitators".*

2.5.1 Commercialization Facilitators

Various studies on innovation management agree that, in order for successful commercialization to take place there has to be certain basic appreciation of the market and its needs, "early involvement" of customers in the product development and the product should be timeously launched in the appropriate and "attractive" market (Pellikka & Lauronen, 2007; Mohr *et al*., 2001; Jolly, 1997). A study by Antioco and Kleijnen (2010) further suggests that an understanding of consumers' adoption intention of new technologies would help in facilitating new products' adoption, while Corkindale (2008) puts much emphasis on developing an appropriate business model for commercialization.

In support of these views, Behboudi *et al*., (2011: 262) boldly states; "for a successful commercialization of an idea, the focus must be on strategies, investment in higher education and university researches, creation of infrastructures for public sector's support from research and development, expanding collaboration between government and universities in training the new generation of researchers, and creation of a strong scientific and technical culture".

In recognitionof the complexities related to TIs commercialization, the Australian Research Council (ARC) in their 1997 Melbourne Consulting Group report propose a six pack action plan with the intention to advance research commercialization performance of university research in Australia. The six key actions include;

- ✓ "create the right academic environment,
- ✓ develop effective commercialization support structures,
- ✓ develop and expand relationships with existing companies,
- ✓ facilitate and increase the number of new spin-off companies derived from university research activities,
- ✓ strengthen the corporate base, and
- ✓ increase the amount of finance available for the commercialization of research and technological innovation" (Rasmussen, Moen & Gulbrandsen, 2006: 520; ARC, 2000).

Some of the key *facilitators* for the successful commercialization of technological innovation identified in literature which will be discussed briefly include: operational budget (Korpp & Zolin, 2005), technological transfer organizations (Siegel, Wright & Lockett., 2007), technology incubation and support (Chen, 2009), entrepreneurial-motivated research (D'orazio *et al*., 2007), enhancing regulatory environment (Weckowska, 2010), and access to complementary assets (Teece, 1986, Teece *et al.*, 1997) amongst many other factors.

2.5.1.1 Operational Budget

In Korpp and Zolin's (2005) research on "the development and commercialization of new scientific and technological findings in a global economy", the authors argue it is not enough to possess great ideas without a budget to support the development and commercialization of the ideas. The authors further lament the need for government's intervention in financing both NPD and commercialization processes. Funding is an important component in the commercialization of TIs. Indeed inventions and technologies will not be commercialized if they are devoid of sufficient financial support. It is, however, debatable in the innovation literature as to whether the private sector or the public sector is the best providers of the commercialization funding. This observation is further reiterated by the Zimbabwe Association of Inventors (2010), which points out that there is a serious problem in bridging the gap between researchers and potential funders as the funders are from a business and not a technical perspective. This has resulted in a gap between commercialization and research.

2.5.1.2 Technology Transfer Organizations (TTO's)

Siegel *et al.* (2007) hint at the important role played by Technology Transfer Organizations (TTO's) in defining the technology transfer processes, systems and objectives as well as expertise matching, intermediating market access to new products, facilitating licensing of inventions and so on. Despite these and other critical functions played by TTO's, Siegel *et al.* (2007) bewail that such TTO's have been either missing in the commercialization picture, or have been misplaced within the commercialization circles. TTOs are thought to play a more beneficial role, according to academic entrepreneurs, providing important guidance and services (Shane, 2004). Lockett *et al.* (2005) find that spending on the protection of Intellectual Property (IP) and the "business development capabilities" of the TTO are positively associated, especially with university spinoff rates and external investments in spinoffs. However, elsewhere, TTO's are viewed as regulators enforcing disclosure rules, but do little to help license technology or create new products (Link, Siegel & Wright, 2014; Bauer, 2001).

2.5.1.3 Technological Innovation Incubation and Support

It is widely recognized in literature that if no support is extended to commercialization, spinouts and commercialization of technology success will remain rare (Pellikka & Lauronen, 2007; Jolly, 1997). Commercialization is normally given less priority even in projects that state it as one of the project objectives. In many cases, even government policies, R & D and commercialization all come up well in writing but when it comes to resource allocation, commercialization takes second place to R & D. In his interrogation of the Taiwanese government's R & D policies, Chen (2009: 93) confidently notes that "the establishment of science and technology parks and supporting high tech industries are factors contributing to the success of this country".

Technology incubation and commercialization refer to nurturing innovative technological ideas, products and processes into active business entities that might eventually graduate into big corporate companies, in the process creating high value jobs and simultaneously injecting resources into local authorities through fees and into the fiscus via taxes. The ideas could be from R & D centres, academia or existing company operations, where R & D is strong. Science and Technology Parks (STP) refer to innovation companies with a physical and/or proprietary attachment to one of the universities or technological centres. The key mission is to provide space for research-based ideas with commercial potential (Kwaramba, 2009).

2.5.1.4 Academic Entrepreneurial Intention

A recent study (Prodan & Drnovsek, 2010) has proven that most "researchers are not entrepreneurs and they do not want to learn how to become entrepreneurs". On a related note, D'orazio *et al*. (2007) acknowledge that much prior research about entrepreneurial intention has focused on appreciating what it takes to become entrepreneurs in different economic sectors. They however note, with great concern, the missing marketing orientation in most entrepreneurial initiatives as well as the missing collaboration between entrepreneurs and researchers. Successful commercialization largely depends upon the interaction amongst and the commitment of entrepreneurs, scientists as well as engineers, equally. Varsities and research organizations in the developing world such as the United States of America (USA), United Kingdom (UK), Canada and Australia are encouraging scientists and engineers to take a greater interest in the development and ultimate commercialization of research outputs, rather than concentrating on purely academic pursuits.

2.5.1.5 Regulatory Environment

The history of promulgating legislation that seeks to regulate the commercialization of research has its roots in the *U.S.A. Bayh-Dole Act of 1980* as well as almost similar legislation in Europe.[1] According to Weckowska, (2010), the *Bayh-Dole Act* is said to be the most popular state policy behind innovation commercialization. The Act has been largely credited for the intensification of innovation patents and licenses in various universities in the USA beginning in the early eighties, when the Act was passed, through to the nineties.

The current research portrays this so that developing nations such as Zimbabwe learn from the developed world and lessons such as these to facilitate their R & D and commercialization efforts. For instance, Zimbabwe does not have a clear legislation, such as the *Bayh-Dole Act*, directed at the university and research institutes' commercialization activities. Furthermore, there seems to be no entity nor government representative that is clearly mandated to direct relevant parties or interested parties in matters regarding commercialization, IP ownership or rights issues.

Contrary to the positive findings about the reported positive impact of the *Bayh-Dole Act*, some researchers (Mowery *et al.*, 2004) stand to disagree. They argue that the USA universities could still soldier on and achieve their recorded research commercialization performance with or without the passing of the Act. Nonetheless, the current study is of the view that the role played by government

[1]For an in-depth discussion of the Bayh-Dole Act and impact, refer to Mowery *et al*. (2001, 2004).

commercialization policies in ensuring that value is obtained from (academic) research output must never be belittled. Past studies presented empirical support for IP protection and its significance in sustaining commercialization of technological innovations. For instance, Gans *et al.* (2007) presents evidence that there is a direct relationship between the degree of cooperation and the innovator's control over IP rights. In the same working paper study, Gans *et al*. (2007) also reports that the patent grant date normally elevates the odds of concluding a licensing deal.

2.5.1.6 Access to "Complementary Assets"

The allocation of ownership and control over "specialized complementary assets" is another determinant of commercialization strategy. When the "specialized complementary assets" are under the control of some other players, Teece (1986) reveals that the innovator is likely to obtain very little from the value that would have been created, and vice versa. Complementary assets are required for successful innovation management to take place (Teece, 1986). This view is echoed by Rothaermel and Hill (2005) and Shane (2001*b*) who explicitly specify that both manufacturing and marketing assets and "generic" and "specialized" complementary assets are required to facilitate successful commercialization of innovations. However, difficulties in accessing and / or acquiring these assets in their various forms may "suppress the market entry of a product by increasing the attractiveness of technology trading" (Rothaermel & Hill, 2005: 54).

2.5.1.7 Correct Application of new product launch decisions

Garrido-Rubio and Polo-Redondo (2005), in their empirical study on the influence of launch decisions on the success of innovations, deduce that a new product is likely to be well accepted by the market if the proposed launch decisions are applied correctly. Thus the authors reiterate the necessity to determine the role of strategic decisions (what, where, when and why) and tactical (how? i.e. product, price, communication and distribution issues) determinants in achieving commercialization success of the new technological innovation. The study suggests that an organization is more likely to achieve success in commercializing its innovations "if, when launching a new product, skimming strategies are used and the product is marketed at prices higher than those of the competition. Moreover, if intensive distribution is used for selling an innovation and the investment in the communication media is greater than that made by the competitors, then it will also be more probable to reach success" (Garrido-Rubio & Polo-Redondo, 2005: 29). The extensive study also recommends the use of print media advertising, electronic media (such as radio, television or the internet) as well as outdoor advertising and direct marketing as useful tools in reaching product launch success with greater ease.

These are further supported of late by Chiesa and Frattini (2011), through the development of a model that comprises of both strategic and tactical variables as dimensions of Commercialization of Innovations (CoI). The duo include, among other strategic variables, decisions related to timing, targeting and positioning and inter-firm relationships. The 4Ps of marketing generally make up the tactical variables of their framework i.e. product, distribution, promotions and pricing of the innovation.

2.5.1.8 Technological Innovations' Attributes

Nerkar and Shane (2007) examine new products' traits that determine and / or contribute to their successful commercialization. In their study, the authors show that the probability of commercialization success is influenced by two features of what they term, "licensed technological inventions", i.e. the scope and pioneering nature of the inventions. The duo thus emphasizes the need for firms to consider the likely impact of the natural world of the technological innovation itself, instead of just focusing on the firm's capabilities. In support of Rosenau (2001), Nerkar and Shane (2003) pronounce that the "radicalness" of a technology, if "combined with broad patent scope", will help in reducing failure. Thus the authors' views are in contrast with various preceding researchers (*e.g.* Teece *et al.,* 1997; McGrath *et al.,* 1996; Teece, 1986) who argue that commercialization success is centered on firm capabilities. However, lack of facts on innovations' attributes before commercialization remains a challenge in exploring this area since most new product development processes remain 'in the closet' until the launch stage, mainly for the fear of *innovation hacking* by competitors – a concept described by current research as a situation where an idea, concept or prototype leaks and is quickly developed and launched on the market by competitors.

2.5.1.9 Academic Spinoff Ventures & Academic Culture

This sub concept of academic entrepreneurial intention has of late generated a lot of interest amongst academics and researchers (*e.g.*, Hayter, 2010; Chesbrough, 2009, 2003; O'Gorman, 2008; Nerkar & Shane, 2007). Academic spinoff ventures are "new firms originating in universities or other research settings" (Hayter, 2010: 54). In fact there are a number of views regarding the academic spinoff ventures concept. These views differ in "parent" organization scope, entrepreneurial team origination as well as the views regarding the extent of knowledge transfer between the "parent" organization and the spinoff venture (Carree & Thurik, 1999).

Samson and Gurdon (1993) however, are against the idea of cultivating and / or importing academic culture in to the commercializing firm, They argue strongly that "academic culture is a key inhibitor

to spinoff formation and success" and hence should be managed in such a way that it is not allowed to permeate through the institute.

2.5.1.10 Defensive Licensing

Technology commercialization can also be achieved through the process of defensive licensing which involves the awarding of exclusive rights by an assigned authority, thus protecting an idea, innovation, invention or new product against competing threats. Contrary to common sense, innovation management researchers argue that defensive licensees are normally motivated by the desire to eliminate an idea on the market rather that the zeal to exploit it or have it commercialized (*e.g.* March, 1991). According to researchers, Merges and Nelson (1990: 840), "inventions with broader scope of patent protection permit the appropriation of greater returns if commercialization is successful than inventions with narrower scope of patent protection". March (1991) *in* Sichelman (2010:6) supports this motion by postulating that "broader scope protection increases the likelihood that any trial-and-error efforts that are necessary to develop new products and services will result in something for which returns can be appropriated because broader patent scope allows the firm exploiting the invention to explore product and service applications over a wider range of technical areas". Nerkar and Shane (2007) describe how such "trial-and-error processes" are capable of allowing numerous applications to come out of one technological invention, and how such multiple applications positively impact on the organizational returns. Exclusive licenses encourage spinoff, especially in the biosciences (Shane, 2004).

Developing countries differ substantially in the kinds of instruments they use because of their considerably weaker research institutional environment. In such developing nations, governments are usually held responsible for "doing nothing more than lip service to the need for accelerated growth and for not harnessing the abilities of their own citizens for technological innovation and entrepreneurship" (Nerkar & Shane, 2007: 1156). Great ideas are either left unpatented or the invention originators' efforts to acquire the much needed protection are frustrated. Critics also grieve for third world countries' dependence on "exogenous and often exploitative technology" (Nerkar & Shane, 2007: 1157). Critics further point to the fact that most developing economies make incorrect or rather "inappropriate choices of technology" for their inhabitants – which are mostly imported. Hence this study also contributes to the search for ways to harvest indigenous capabilities. Specifically, it is an in depth investigation of the factors that deter the transformation of developing economies' new technological innovations into the marketplace, with a view to prescribe solutions thereof.

2.5.1.11 Commercial Experience

Vohora *et al.* (2004) and Nekar and Shane (2003) share the same sentiments that the research institute's experience in liaising and collaborating with the industry enhances its "ability to recognize entrepreneurial opportunities" and thus improve success chances of the new product. In addition O'Gorman *et al.* (2008) and Audretsch *et al.* (2005) also argue the same. They view the industry's working experiences, co-publishing with the industry, co-patenting, and serving as advisors on the company's scientific board as some of the key commercial-related prerequisites for successful commercialization.

2.5.2 Factors Hindering the Successful Commercialization of Technological Innovations

According to Zahra and Nielsen (2002), the commercialization of technological innovations is very uncertain. In fact, there are various barriers to the commercialization of new technologies. Different authors have different and similar views on these barriers and uncertainties. For instance, Wustenhagen *et al.* (2008) talk extensively of "technological spill over", which they say is a situation where an innovator fails to appropriate the full value of their innovation. Secondly, there is a "fundamental uncertainty", described by Geels *et al* .(2008:524) as the "uncertainty about new technology pathways, markets, user practices and regulatory frameworks providing an uneven playing field for technology-based ventures". This form of uncertainty brings to light the significance of entrepreneurs' ability to persuade the socio-economic system and, most importantly, to overcome the TI commercialization barriers (Dean and McMullen, 2007).

As outlined previously, literature on the challenges faced by innovators in their attempt to bring their invention to the market points to a phenomenon referred to as the "innovators' dilemma" (Slater and Mohr, 2006). Christensen (2000) argues that market leaders in particular experience some challenges in the diversion of resources from developing "sustaining innovations", especially in a mature market, to the development of "disruptive innovations", which are reportedly said to"too often underperform established products in mainstream markets …". The USA Congress of 2005 gives a different dimension when it notes a different set of factors which could impact commercial success of the TI, inclusive of:

- ✓ "the nature and composition of markets;
- ✓ competition from older technologies,
- ✓ choices of design and implementation, the availability of financing,
- ✓ standards, and complementary assets or infrastructure, and

- ✓ the ability to link with strategic partners".

Other contributors also quote a "cultural and structural barriers" as inhibitors to research commercialization and most of these are somehow contextual i.e. dependent on a firm or a country. According to Attewel (1992), the main commercialization determinants related to the dynamic business environment in commercializing research include: "the quality of the research base and the maintenance of science and technology skills, the availability of companies willing and able to take up the results of research, the strength of links between the research base and industry, availability of venture capital, the quality of management skills, an appropriate regulatory environment, and a competitive business environment" (Sohn & Moon, 2003: 897).

It is uncontroversial to say that there are indeed various hindrances to the commercialization of the technological innovation process. Various authors have proposed different ways of categorizing the factors that hinder the successful commercialization of technological innovations. Zaidi and Naeem, (2005) demonstrate the factors that stand in the way of successful commercialization of government-funded research results as, "inter-alia:

- absence of demand-pull approach in project selection,
- search for technical excellence at the cost of commercial reality,
- mismatch of objectives and interests of R & D institutes and corporate objectives,
- technological gaps between R & D institutes and firms,
- time-lags in transfer, lack or loss of credibility of R & D institutes,
- lack of sustained follow-up,
- transformation of overseas educated elite into desk managers of R & D,
- expectation for too quick results without sustained efforts,
- lack of an integrated approach,
- failure of government in providing technology infrastructure,
- lack of autonomy given to the research institutes and industry", and so forth.

2.5.2.1 Weaker Technology Infrastructure

Regarding this barrier, Laranja (2009: 23-24) explicitly states; "ill-equipped, under-staffed and under-financed laboratories in the universities and research and development institutions find it difficult to assume the role of guiders". The lack of proper infrastructure that promotes commercialization does more harm than good. This appears to be a major challenge in developing economies where the limited resources are channeled towards the infrastructural development for R & D only, at the expense of commercialization of the technological innovations developed.

2.5.2.2 Understanding the "Valley of Death"

This phenomenon is used as a metaphor to describe the relative lack of resources and expertise in the front end of product innovation (Markham *et al.*, 2010). The scientists may not necessarily be interested in seeing their output through to the market through commercialization. Quite often, whether there is commercialization interest or not, the familiar remark has been, "for every dollar invested into basic research, which is critical to the economy's competitive strength, almost one hundred dollars is required for a competitive product to be produced" (McNeil *et al.*, 2007: 8). Policy makers, government agencies and venture capitalists are challenged to make efforts to close the gap that exists between R & D and commercialization. This study thus concludes by proposing a framework to guide policy-makers in closing gaps such as these.

2.5.2.3 Underinvestment into the "Development of New Technologies"

Tassey (1991) claims that underinvestment in new technologies development handicaps the ultimate commercialization of such technologies. He attributes such underinvestment to have been "caused by general R & D-specific and market related risks". Investors are generally said to be skeptical to invest in research projects or new technology development projects with a large value commitment, and which are long-term in nature, since the risk is too great. The perceived risks which Tassey (1991) refers to include technical risks, the intensity of investment for R & D activities, long time-lag between development and marketing, as well as the presence of a wide range of potential markets.

2.5.2.4 Technology- Market Mismatch

It is generally agreed that new technologies are accepted if there are complementary technologies, product and services (Zhou *et al.*, 2005; Sutton, 2001). In fact, Shillito (1994) talks of the need to ensure the match not only between the technology and the market, but also with company needs. Such pronouncements only echo the undoubted role played by internal marketing in external marketing (commercialization in this case). Brabec (2004) notes that successful commercialization can only result from some technology drivers and these include ensuring that there is a perfect match between the technology and the intended market. Di Zhang (2015:258) tends to offer a different opinion as he argues that marketing orientation cannot envisage successful commercialization of technological innovations in that "strong commitment to current markets leaves firms beholden to customers who typically have neither the foresight nor the interest for radical innovations." It does not matter if the market is small as, new technologies targeted at niche markets are likely to meet limited resistance due to limited likely mismatches. In comparison, larger markets offer high mismatch chances which are likely to hinder successful commercialization.

2.5.2.5 Lack of Cooperation and Linkages for Market-Driven Innovations

Even though a match is found between the market and the technological innovation, there has been general consent amongst practitioners and intellectuals that research institutes can increase their chances of success in commercializing especially technologically intricate inventions when they collaborate with others and with each other. For instance, Chandran, Farha and Veera (2009) write extensively on the need for close collaboration between research institutes and the industry in placing inventions in the market place. In the context of Zimbabwe, such collaborative R & D activities amongst industries are still at grassroots level, fueled by restrained absorptive capacity and political instability, which deter mostly external partners.

Current research is also in agreement with Rasiah and Charan (2009) that there is need to change the way the industry views or perceives universities and research institutes. To say the least, it has been established in the circles of innovation management research that the industry, which is expected to co-exist with innovating institutions, does treat such co-existence and cooperation as essential innovation springs. However, Zimbabwe can still draw quite a number of lessons from emerging economies such as South Africa and Malaysia who are making efforts to capitalize on these collaborations (Chandran, Rasiah & Wad, 2009). Issues relating to these collaborations are covered in much detail in subsequent sections on PPPs.

2.5.2.6 Organizational Obstacles

In addition to external factors that are market-related there is an array of organizational specific internal factors. In a study of small, technology-based firms (Pellikka & Malinen, 2014; Pellikka & Lauronen, 2007), it is established that most of these firms experience resource limitations and capability constraints. In an almost similar study entitled, "Fostering commercialization of innovation in small high technology firms", Pellikka and Lauronen (2007) also establish that it is not only limited resources but the imbalances in the allocation of scarce resources. Though these have been prominent challenges in small firms in developed economies, current research indicates that the same have also threatened large research institutes in developing nations such as Zimbabwe. This has further handicapped the efforts to internationalize the local innovations. Possession of managerial competences and experiences are also identified as keys to successful commercialization performance. Jones-Evans (1997) identifies "lack of marketing competence" as a major handicap to successful commercialization, particularly prevalent amongst the so called "technical entrepreneurs with backgrounds in scientific and technological development". Öberg and Shih (2014) give insights on how divergent, rather than convergent logic inhibit innovations, i.e. failure is likely to occur when members of the institution have different priorities, interests and interaction goals.

Chandran *et al.* (2009) cite lack of qualified staff as one of such organizational obstacles that significantly affect the innovation management as well as how the relevant new product information is disseminated to relevant stakeholders such as the industry and patenting organizations. The same authors also append that the "absence of adequate technology management practices and lack of experience serves as the major obstacle to poorly established linkages" (Chandran *et al.*, 2009: 368). It is a known fact in the realms of innovation studies that while many Research and Development (R & D) structures in the developed world have evolved to the fourth generation (4G), concentration has been on striving to meet customers through appropriate "technical feasibility and marketability" analyses during preliminary stages (Liyanage *et al.*, 1999; Miller & Moris, 1999). It is apparent that the majority of research institutes in developing economies such as Zimbabwe are in the first generation phase where, according to Chandran (2010), focus is dedicated to "science-based R & D laboratories" thus restraining the consideration needed for innovation management, which encompasses commercialization.

2.5.2.7 Information Exchange Barriers

It has been reported that research institutes, researchers and potential investors usually find it "too resource intensive" to establish R & D, IP and commercialization opportunities. On the topic of information exchange barriers, Johansson, Kisch and Mirata, (2005) express concern over the long time consumed yet with no results guaranteed even though the engagement may be worth pursuing.

2.5.2.8 Lack of Commercialization Funding

Several studies illustrate that finance is an essential contributor to facilitating the successful commercialization of innovations (Chandran, 2009). In terms of new product development costs, a study by Norris and Vaizey (1973) postulates that the research phase accounts for between 5% and 10%, while product development is said to be accounting for 10 to 20%, and commercialization is said to account for 70 to 85% of the total costs of introducing a new product to the market. This is confirmed by Hultink *et al.* (2000) who notes that commercialization is the most expensive stage of the new product development process. From these studies, it is thus clear that the investment required at the R & D phase is comparatively small in comparison with the investment required for commercialization.

For private institutes, these funds usually come from research institutions or industry themselves, 'angel investors' (Chandran, 2010: 27), venture capital markets, or in the form of government grants. Public research institutes rely solely on government and donor funding, among other related forms of funding. Since access to these 'angel investors' and venture capitalists is limited, especially in

developing economies like Zimbabwe, the proactive action by the government thus becomes pivotal in providing financial support for identified feasible research outputs that have commercialization potential in both the private and public sectors. Such funding and / or proactive response lacks in most developing economies, hence commercialization of technological breakthroughs has been crippled in such economies. Research institutes in developing economies also face difficulties in accessing funds through bank loans and equity agreements, not only during the commercialization phase but also during the concept development and expansion phases.

2.5.2.9 Failure in High-Tech or Low-Tech Markets?

Chiesa and Frattini (2011) in support of Bayus (1994), Chakravoti (2004) and Gourville (2006), distinguish between commercialization hindrances in different types of markets. More specifically, Chiesa and Frattini (2011: 540) lament that, "… in high-tech markets, the difficulties encountered by firms in commercializing technological innovation are exacerbated by the volatility, uncertainty, narrow 'window opportunity', interconnectedness, and proliferation of new technologies that characterize such markets…". This is undoubtedly evidenced by the scores of new high-tech products that fail to make it to the market mainly as a result of "poor commercialization".

Amalgamating thoughts from innovation management studies, innovation diffusion literature, and marketing-based research; findings from the study by Chiesa and Frattini (2011) show that the commercialization of an innovation indeed impacts on customers' approval or acceptance of new products. This takes place through impacting the extent to which innovation adoption partners support the new product. This also takes places through the extent to which early adopters' attitudes towards the innovation affects the type of word-of-mouth (positive or negative) they trigger among later adopters. The same authors also reveal that both, lack of, and limited support from the "innovation's adoption network" and pessimistic attitude by especially early adopters are also significant reasons for commercialization failure especially for systemic and for radical innovations, respectively.

However, regardless of being low or high-tech, current research is of the view that these hindrances to successful commercialization do not vary much from one market type to the other. For instance, improvements in communications (mainly through internet and mobile telecommunications), resulting in interconnectedness and proliferation of other new technologies is now the order of the day in both developing and developed economies. This has resulted in dominance of social networks across the world. Firms even in the smallest part of the world have now rely much on global markets for their inventions, and this, Chakravorti (2004) has resulted in markets changing to adopt the nature and characteristics of networks. Thus the factors hindering commercialization successes often overlap,

hence focus should rather be placed on finding means to reduce or manage the challenges so as to increase the chances of success.

2.5.2.10 Failure to Grant Ownership of IP Rights to Researchers

The OECD (2003), through their cross examination of the impact of Intellectual Property Rights (IPR) in enhancing innovation, creativity and commercialization, conclude that awarding IPR and "national incentives" for innovation motivates research institutions to commercialize their produce. However there remains a scholarly debate regarding who should hold the IPR – the researcher or the institution.

With firm reference to different economy's variations, Mowery *et al*. (2004) strongly defends the *Bayh-Dole Act of 1980* for its ability to facilitate state funded researchers to obtain some patents and grant licenses. In Canada, about half of the universities grant ownership to individual researchers with the other half retaining titles. Whilst in Australia, the universities have directly transferred IPR to individual researchers. In Germany, a new law will shift title to invention from the professor to the university; similarly Italian government implemented a law in 2001 granting IP ownership to researchers at universities. In the UK there are various sets of rules for example while most research councils grant IPRs to institutes. In Japan (Nonaka & Hirotaka, 1995), title to an innovation is said to be determined by a committee which normally makes decisions in favour of researchers. In developing African countries, there is generally either no clear law governing these rights or the process to acquire such is burdensome.

2.6 EMPIRICAL STUDIES ON FACTORS HINDERING COMMERCIALIZATION OF TECHNOLOGICAL INNOVATIONS

Numerous studies have been conducted the world over to identify the barriers to commercialization of research outcomes. Behboudi *et al*. (2011), in an Iranian study, examines the commercialization of the country's research outcomes. The research team identifies 33 factors affecting commercialization of technological innovations and groups them into six major clusters - research-orientated, industry-orientated, the government related factors, technology parks (techno-parks) and growth centres, environmental and commercialization related factors. Interestingly, in an older study, Zaidi and Naeem (2005) categorize the factors thought to hinder commercialization of technological innovations in Pakistan as technical factors, organizational, environmental, social, financial and policy related. The differences in categorization may point to the fact that the factors that hinder the commercialization of innovations vary from one country to another. Table 2.2 below summarizes the

categorization of the various factors hindering commercialization of innovations in Pakistan as propounded by Zaidi and Naeem (2005).

Table 2.2: Categorization of Factors Hindering Commercialization in Pakistan (Zaidi and Naeem, 2005: 5)

TECHNICAL	**ORGANISATIONAL**
Major	*Major*
Unavailability of Resources	Weak Technology Infrastructure
Technology Capability Gap	Flaws in R & D Management Functions
Technical Unreliability	Slow pace of Bureaucratic Practices
Delay in Transfer	Lack of Experienced R & D Personnel
Unavailability of Data on Resources	Restricted Planning Horizon
Minor	Low Remuneration of Research Staff
Need for Techno-Managerial Actions	Lack/Loss of Credibility of RI
Technical Uncertainty Too Great	Lack of Committed Leadership
Market Potential Not Established	*Minor*
Immature Technology	Lack of Vision to Read Changing Trends
Market Competitiveness not Established	Lack of Team Cohesion
	Inadequate Information Dissemination
	Lack of Multi-Disciplinarity of RI
	Lack of Organizing Ability
FINANCIAL	**SOCIAL**
Major	*Major*
Unavailability of Committed Resources	Industry Prefers to Import technology
Fee for Technical Assistance (TA) Denied by Industry (63%)	Low Morale of the Research personnel.
Unavailability of Resources	*Minor*
Minor	Fear of Increase in Unemployment
Time-lag in Transfer Affects Economics	Negative Effect of Not-Invented-(NENIS) Syndrome
Operational Inefficiency of Technology	
ENVIRONMENTAL	**POLICY RELATED**
Major	*Major*
Environmental Unsoundness of Technology	Inadequate Technological Infrastructure
	Market Protection or the Lack of It
	Minor
	Restricted Mobility of Personnel
	Inclination for Academic Research

It can be concluded from this study's findings that the factors hindering successful innovation commercialization are therefore:

- numerous;
- equally critical despite being labeled "major" or "minor";
- intertwined i.e. they are linked to one another. Due to this interlink, the study reported that that "the fate of the commercialization process is in fact entrapped in a vicious circle in which it is difficult to trace the starting point or an end" (Zaidi and Naeem, 2005: 5) ; and
- emanate both from within the organization (internal) and from outside the organization.

More recent studies emphasize the significance of supportive and / or collaborative institutional arrangements for effectual commercialization of technological innovations (*e.g.* Gupta *et al.*, 2014; Saruchera *et al.*, 2014*a*; Chadee and Roxas, 2013). These studies classify research commercialization as a socio-economic activity and they make an inherent assumption that such as, is moulded and

restrained by institutional environment that comprises of formal laws, regulations, procedures, informal conventions, customs and norms". Some of these specific studies shall be discussed in separate section of this study.

2.7 CONSUMER PERCEPTIONS IN THE COMMERCIALIATION OF TIs

Schrage (2005) encourages commercializing firms to place much value on consumers compared to inventors and / or entrepreneur given that commercialization is reported as an activity of the customers. According to Schrage (2005), both individual and corporate and individual customers are the reasons for the success of both reality and ideas marketplace. Thus for this reason, Corkindale (2008) notes that if the firm has not managed to attract what he terms, "'great customers" then it may have to revise its commercialization methodologies for new technological innovation. Corkindale (2008) further notes the need for any business or commercialization model to account for "the availability of great customers". With this in mind, it is important that new product marketers appreciate market perceptions of the new product as these will normally determine the sustainability of the new offer.

2.7.1 Wrong Target Market

Research has proven that several firms usually target their new offerings at the wrong market (Friar & Balachandra, 1997) thus the new product fails to be successful. When this happens, the business model used to commercialize the new product is usually said to be "flawed". Therefore there is a need for new product marketers to consider placing the right product within the confinements of the appropriate target markets if maximum value is to be obtained from the new offering. Literature has it on record (Teece *et al.*, 1997) that the first marketers of a new technology are not necessarily the ones who consequently reap profits from it – poor target marketing has been singled out as one of the chief reasons for this anomaly. Competitors normally learn from the first marketer's mistakes and strive to improve on such.

The current study is of the view that, although it is not easy to decide on the appropriate target market for new technology, which might be under test and scrutiny by early adopters, efforts should be made to get the innovation into the right hands. One way of doing this is through carrying out an effective test marketing exercise for the new offering before its full commercialization.

2.7.2 Innovation Types vis-à-vis Consumer Perceptions

Because the term "innovation" has been used quite loosely (Chesbrough & Rosenbloom, 2002), three categories are defined. The first category comprises what are known as; "Discontinuous innovations" (DIs) (originally established by Robertson, 1967), which consist of "something with a completely new-to-the-world set of attributes and this usually gives rise to a new product category or industry". The second category is made up of "Continuous Innovations" (CIs) that comprise "something with small-scale alterations or enhancements to existing products". Lastly, "Dynamic Continuous Innovations" (DCIs) prevail "where the technology may be new but the product into which it is put is, to all intents and purposes and as far as the user is concerned, just an improved or different form of what already exits" (Corkindale, 2008: 9) DVDs are given as classic examples of DCIs.

Consumer perceptions regarding these different categories of innovation do vary. For instance, Mohr *et al.* (2005) postulate that DIs call for, and also entice a change of behavioral changes in their users, as they are perceived to be new-to-the-world. Moreover, the fact that DIs require a unique set of manufacturing, supply chain and marketing processes (Corkindale, 2008) implies that they command a unique set of customer perceptions and market interactions. Thus, compared to CIs, DIs are reportedly difficult to obtain an appropriate market for. Marketers therefore ought to take great care regarding perceptual and target market selection issues regarding the different types of innovation.

2.7.3 Market Location

Customers do not like changes, especially when they are not rationally justified. Propping up the recommendations made by Friar and Balachandra (1997), Moore (2002) expresses the fact that "if a DI-based product is aimed at replacing the incumbent one it will unavoidably meet strong competition from the products and services providers that utilize the existing technology". Normally, existing customers will adopt such "breakthrough products" either if they perceive the product location to be accessible or are just perceivably keen to support the product. Accessibility plays a critical role in commercializing new products, especially in building customer perceptions of the new offering. It is thus imperative that location choices are integrated into the new product launch decisions.

2.7.4 Managing Perceived Risks

Past studies, amongst them, Mohr *et al.* (2005), have hinted that any firm with the commercialization intentions for the innovations are faced with the need to deal with two types of risks: (1) technology risk i.e. "the risk that the technology fails to work as expected or does not deliver its full promise when it has to function under scaled-up, everyday working circumstances" ; and (2) the market risk,

i.e. “the risk that the expected or hoped-for customers do not buy and/or use the product due to various negative perceptions held of the new product”.

Friar and Balachandra (1999) thus pronounce the principle that the commercializing firm should make efforts to lessen the market risk, rather than eliminating it. This, the authors say, can be done through making correct choices on “product-market strategy”. This move is supported by Millier and Palmer (2001) who also weigh in by elaborating on the need to consider the level of risk the firm can sensibly carry when making potential and / or target market choices. The duo advocate for the application of Abell and Hammond’s (1979) “Market Attractiveness – Business Position Strength procedures” to managing risks associated with new product commercialization. The authors however recommend that small firms utilize the “acceptable risk strategy” which focuses on gradually reducing the “high risk”.

2.7.5 Post-Purchase Attitudes and Perceptions of the Innovation’s Early Adopters

Preceding studies have established that new product “early adopters” are more likely to react negatively towards the offering post-purchase and after using the product. Such behaviour is commonly describes as “cognitive dissonance” in retailing and marketing circles (*e.g.,* Gbadamosi, 2009; Harmon-Jones & Harmon-Jones, 2000). The current propositions are specifically grounded on literary assumptions on “product trials, attitude change and customer satisfaction” studies, which can be traced back to the mid eighties (*e.g.* Leonard-Barton, 1988; Richins, 1986). Thus if these adopters, who normally assume the “opinion leader” roles, are dissatisfied with the innovation, they can proffer unconstructive opinions which, in turn, negatively affect the adoption of the new product by the rest of the market. Negative perceptions crowd the minds of the potential consumers thus affecting the product’s potential sales. This gives a clear indication that there is a need to manage not only pre-commercialization or pre-launch activities, but also post-purchase behaviour of consumers. Nothing much is however said of how this post-purchase behaviour can be managed, particularly in cases of commercializing new products – a gap that the current study partially attempts to address.

2.7.6 Perceptions on Radical Innovations

While most of the preceding views focus on perceptual issues regarding new products in general, radical innovations seem to be perceived quite differently. In support of Rogers’s (2003) view, Chiesa and Frattini (2011) postulate that the radical innovations’ adoption and the early adopters’ post-buying attitudes towards the innovations largely impact the buying decisions by ensuing late adopters. This

professed impact is based on the notion that the "diffusion of innovations" follows a certain trend or order from one group of customers to another (Moore, 2002). Rogers (2003) however criticizes this line of thinking, citing lack of proper empirical evidence to support the diffusion as a "process". Whatever consensus and arguments emanate from these scholarly views, what remains clear in these views is that one consumer's attitudes and perceptions towards a particular new product can "diffuse" through to other potential customers, thus impacting the potential customers' purchase intentions. Creating the correct first impression of the innovation to both the innovators and the early adopters of the product can save the firm from the negative diffusion of facts.

2.7.7 Country of Origin (COO) concept

Research related to products' Country of Origin (COO) has commanded increasing interest since the early seventies (*e.g.* Haakansson and Wootz, 1975; Nagashima 1970). Later on, more specific studies on COO were carried out – studies related to the effects of COO on product evaluations (Bilkey and Nes, 1982), COO effects on perceived value (Han and Terpstra, 1988; Johansson *et al.*, 1985), on national image and competitive advantage (Jaffe and Nebenzahl, 2001), the impact on product distribution (Brester *et al.*, 2004) and legislation governing COO (Peterson and Yoshida, 2004; Johansson, 1993) among many other related issues. Interestingly, COO legislation (COOL) has emphasized consumers' rights to be educated about the product source and be permitted to make choices, while their critics argue that it is not necessary to implement COOL as they deem it expensive and the concept has been primarily used as a basis for comparing quality instead of measuring product safety (Lim *et al.*, 2013; Maheswaran, Chen & He, 2013; Peterson & Yoshida, 2004; Johansson, 1993).

More recent studies, however, confirm that customers would generally prefer their own local technological innovations to imports. For instance, Lee, Lee and Lee's (2013) work adds weight to the findings of Klein (2002) that under normal circumstances, consumers will normally choose their own brands, which they are quite confident of. However, the current research notes that much of these studies have focused on food items, mostly meat related products (Knight *et al.*, 2007; Loureiro & Umberger, 2007; Bilkey & Nes, 1982). It could therefore be the case that customers will naturally choose locally prepared foods to avoid certain recipes, ingredients and preservation methods that may not be in line with the local requirements, social norms and culture. The question begs asking, "Is it the same when it comes to technological innovations?" Thus this study relates this COO issue to how consumers perceive various technological innovations, other than food items.

2.7.8 Perceptions regarding new product pricing, quality and value

A few studies have confirmed that consumer perceptions of "price, quality, and value" (PQV) are the "pivotal" determinant factors of buyer "shopping behavior and product choice" (*e.g.* Haws & Bearden, 2006; Varki & Colgate, 2001; Zeithaml, 1988; Jacoby & Olson 1985; Doyle 1984). In a more specific study, Haws and Bearden (2006) address how consumers perceive dynamic pricing, in response to market segment differences, as fair or unfair. The same goes with quality perceptions which may be perceived as "good" or "poor" quality, though this is at times associated with brand and / or store name (Rao & Monroe, 1989), COO (*e.g.* Lee *et al.*, 2013; Brester *et al.*, 2004), the perceived "originality" of the brand, and the value attached to the (new) product. These later studies seem to borrow much from the work of Zeithaml (1988) whose work is more inclined to modelling and synthesizing the consumer perceptions of the perceived "pivotal" three factors – price, quality and value.

2.8 PRIVATE-PUBLIC PARTNERSHIPS (PPPs) IN COMMERCIALIZATION

Private-Public Partnerships, hereafter referred to as PPPs, have indeed become prominent of late, and their importance has become more significant over time. Jamali (2004, 2007) observes and notes the greater than ever importance being placed on the market mechanism, coupled with the success stories of privatization cases in various countries as some of the interest enhancers in the continuously rising PPPs phenomenon. PPPs have thus turned out to be increasingly quite a common as they have been perceived to be one of the lasting solutions in instilling some element of "dynamism" especially in public service delivery. Over the recent years, the public sector has been faced with various conflicting pressures emanating from global competition, public debt problems and a more sophisticated and demanding consumer base (Ancarani & Capaldo, 2001; Wright, 1994; Aram, Lynn & Reddy, 1992) thus the sector has been challenged to perk up its performance by bringing into play some "market-like approaches" into public service delivery, public sector management activities, and "focus on constantly improving service quality" (Kelly, 2005: 76), and PPPs have appeared on top of the recommendations list. However, while research on R & D networks is abundant, network relations in the commercialization of innovations have attracted surprisingly little attention and consideration (Aarikka-Stenroos, Sandberg & Lehtimäki, 2014; Aarikka-Stenroos and Sandberg, 2012) and lack of an organized or systematic assessment of the guiding principles and necessities for successful implementation of PPPs has been noted (Jamali, 2004) predominantly in developing economies such as Zimbabwe.

2.8.1 PPPs Defined and Conceptualized

Mouraviev and Kakabadse (2012) critically assess the various viewpoints on different types or forms of PPPs, together with their respective modelling constructs – from which insights are drawn for both transitional and developing countries. The term 'Public-Private Partnership' (PPP) isdescribed mainly from contractual (Renda & Schrefler, 2006) and institutional (Hall, 2008*a*) perspectives, thus it is important to contextualize the PPP, given that the term is understood differently.

For instance, Witters *et al.* (2012: 81) describe a PPP as "a relationship in which public and private resources are blended to achieve a goal or set of goals deemed to be reciprocally beneficial both to the private entity and to the public". While Sedjari (2004: 303) notes that "a PPP is a new cultural phenomenon by itself" and defines it as an "a culture of engagement…a capacity for the collective mobilization of participants which now forms the substance and strength of public programmes…" According to Nijkamp *et al*. (2002: 1865), a PPP is defined as "an institutionalized form of cooperation of public and private actors, who on the basis of their own indigenous objectives, work together towards a joint target". In contrast, Jefferies (2006: 452) views PPPs as rather "means of public sector procurement using private sector finance and best practice, thus they can involve design, construction, financing, operation and maintenance of public infrastructure and facilities, or the operation of services, to meet public needs". Various authors argue that PPPs imply collaborations meant to achieve common goals, at the same time leveraging joint resources and capitalizing on the respective competences and strengths of both public and private partners (*e.g.* Jamali, 2004; Pongsiri, 2002; Widdus, 2001). Before concluding that there is no common accord on the meaning of PPPs, Haque (2004) underlines mutuality and organizational identity as the two key features for such partnerships.

More views and perspectives of PPPs can still be gathered as the concept has attracted worldwide attention and has become of much interest, especially in the context of developing economies. The current study acknowledges the diversity in interpretation and application of PPPs. Different scholars have concentrated on selected characteristics of PPPs. Taking into account varying conceptual frameworks proposed in preceding PPPs studies, Mouraviev and Kakabadse (2012) have come to the realization that although there are different perspectives of PPP analysis, the bulk of the studies can be sorted into three major domains: "partnerships as a policy tool"; "PPPs as organizational and financial arrangements"; and "PPP performance, risk allocation, and critical success factors". To this end, the duo has summarized the underpinning theories as follows:

Table 2.3: Principal Studies and Underpinning Theories of PPPs

PPP studies	Underpinning theory	Core assumptions	Influential authors
PPPs as a policy tool	Theory of market efficiency; value for money	Private markets are superior to the public sector in efficient resource allocation. PPP brings more benefits than drawbacks	Osborne (2000), Wettenhall (2003), Grimsey and Lewis (2004), Hodge and Greve (2005)
PPP as organizational and financial arrangement	Value for money; transaction cost economics; governance theory	PPP should ensure lower costs and greater benefits compared to government in-house service provision. Effective governance is the key to success	Klijn and Teisman (2000), Asenova and Beck (2003), Vining and Boardman (2008)
PPP performance, risk allocation, critical success factors	Effective risk allocation theory; governance theory	Risk should be transferred to the party best able to manage it with the lowest cost. Effective governance is the key to success	Hall (2008a, b), Sadka (2007), Morallos and Amekudzi (2008)

Source: Adapted from Mouraviev and Kakabadse (2012: 264)

McQuaid and Scherrer (2010), however, sum up most of the preceding studies on PPPs and conclude that all PPP forms can be categorized as follows: services provision (inclusive of infrastructure), ownership i.e. introducing private sector rights into state businesses, generating commercial value from public assets through selling of public sector services to others, as well as Promotional PPPs.

As noted above, it can be concluded that there are various forms and / or types of PPPs and each form involves a unique set of rules and requirements in terms of investment, which eventually impacts on the degree of risk(s) involved. Developing economies could thus learn from success stories by different economies who have adopted different forms of PPPs. A starting point would rather be going for those PPP forms that involve less risks before embarking of high-return but highly risky projects. For this reason, PFPs have become very common as they have demonstrated their capability to be a good starting point for any PPPs in any economy.

2.8.2 The Role of Private-Public Partnerships in Commercialization

Mustafa (1999) writes that PPPs are critical especially in tackling the widespread challenges and problems that are associated with public sector procurement; challenges such as soaring construction

costs, construction overruns, and some identified operational inefficiencies, poor design, in addition to general community dissatisfaction. PPPs are thus mostly grounded on the notion of private-to-public sector transfer of risk, the assumption being that private players are better equipped to manage risk comparatively well (Jefferies, 2006). Earlier on, Grimsey and Lewis (2002) however, noted that this transfer calls for some profit incentive if the desired outcome is to be achieved.

2.8.2.1 Innovation Risks Sharing

Past studies reiterate that risks are inevitable in the development and commercialization of TIs (*e.g.* Mohr *et al.*, 2005). In cognizance of modern day's economic environment, Witters *et al.* (2012) argue that PPPs rather entail the formulation of contractual agreements and these are formulated between an appointed public sector agency or public-sector authority and a private-sector entity. These contracts permit for greater private involvement and participation public services delivery, or in developing an environment that improves the public's standards of living. Under such a "legal construction", the PPP players can share everything from risk, and the rewards, right through to sharing responsibility for investment (Akkawi, 2010). PPPs are therefore not merely paraphernalia for project funding - they call for full dedication from all parties involved to ensure that minimum risks prevail.

2.8.2.2 Facilitating Commercialization Innovations

According to Witters *et al.* (2012), the legal framework for a PPP formation entails a tripartite arrangement, and these go a long way in facilitating commercialization of TIs. "First, it can be used to introduce private-sector ownership into state-owned businesses through a public listing or the introduction of an equity partner. Second, it can become a private finance initiative, where the government takes advantage of private-sector management skills by awarding long-term franchises to a private-sector partner, which assumes the responsibility for constructing and maintaining the infrastructure and for providing the public service. Third, it can cover the selling of government services to private-sector partners, which can better exploit the commercial potential of public assets. In these three arrangements, the private-sector consortium typically forms a special company, called a 'special purpose vehicle' (SPV) - to develop, build, maintain, and operate the assets for the contracted period. In cases where the government has invested in the project, it is usually - but not always - allotted an equity share in the SPV" Witters *et al.* (2012: 81).

By exposing the technological innovations invented in the public research institutes to the natural market forces of demand and supply and to competitive bidding, PPP's allow the TI's quality, value and cost to be compared to the prevailing international market standards (benchmarking), hence enhancing efficiency and effectiveness (OECD, 2003; 2002).

2.8.2.3 Economy Sustainability through PPPs

Past studies reveal and demonstrate how PPPs improve living standards through enhanced innovativeness and "forward-thinking policies" from governments, and support from nonprofit organizations (Crozier, 2010). Witters *et al.* (2012*)* support this notion as they qualitatively qualify and affirm this assertion. Of PPPs and living standards, Witters *et al.* (2012) state: "…today's cities too can be transformed by forging PPPs that encourage new ways of doing things…". The authors further pronounce a blessing upon PPPs through technologies (ICT), which they say are helping in strengthening and growing PPPs outside past limitations. Thus these partnerships can revive the economy and improve living standards through employment creation, education, economic development, public safety and security, medical, and other social services. Instead of reducing expenditure on these critical public services, the government may encourage the involvement of private players and transform the manner in which such products and services are developed, commercialized and distributed.

2.8.2.4 PPPs Drive Innovation

Regarding innovation and PPPs, Witters *et al.* (2012) posits that PPPs are the key ingredient for driving innovation. The co-authoring team whose study particularly focuses on "the role of Public-Private Partnerships in driving innovation" has strong reasons defending this position. The authors (Witters *et al.,* 2012: 82) expressly state:

> *"PPPs help governments become more inventive by creating a space outside the government structure that allows innovation to flourish. They also help to inject a broader set of skills and talents, as well as a more diligent and responsive work culture into the government machinery and to create a solid foundation for innovative thinking and creativity. PPPs also help private companies embrace innovation and bring together new financial resources and business capital to help open the door for the creation of new industry clusters, thus ultimately helping to facilitate innovation in increasingly competitive environments. Moreover, PPPs allow private companies to engage in large-scale projects that go far beyond their traditional capacities. PPPs have gained particular relevance in the ICT sector".*

2.8.2.5 Use of Private Sector Expertise

Besides provision of quicker and long term private financing options (NCPPP, 2003), PPPs ensure that the private sector's know-how in terms of general management, technology management,

marketing, and customer relationship management is fully utilized in the achievement of the public sector objectives (Brinkerhoff & Brinkerhoff, 2004; Sedjari, 2004). Thus it can be concluded that PPPs provide a platform upon which the state can provide capital resource outlays that will help in R & D, for example the infrastructures and natural resources; while the private players will use their marketing skills to allow the TI to successfully enter the market. In this way, commercialization is enhanced.

2.8.2.6 PPPs visas-vie Innovation Policies

Nurturing relationships in the National Innovation System (NIS) has become one of the R & D, and commercialization major policy focus areas, with PPPs being the main policy instrument. Recent research (Witters *et al.,* 2012; Akkawi, 2010) begins to appreciate the essence of PPPs in the commercialization of TIs and the need to embed such in innovation policies. For instance, the European Commission has worked towards establishing a legal framework for creating PPPs and ensuring risk and responsibility sharing (European Commission, 2011; Europa, 2010).

Back in Zimbabwe, a study by Akkawi (2010) reveals that in some parts of the Middle East and North Africa, the PPPs concept is too taking centre stage. It is apparent from these observations that any commercializing policy should revolve around linkages and PPPs make the policy complete. Zimbabwe can thus derive some lessons from the above case studies through making a move to establish a legal framework to develop and make the use of PPPs transparent and incorporate tehse into the national context for the betterment of the economy.

2.8.2.7 PPPs Improve Economic Competitiveness & Modernize National Infrastructure

The concept of PPP's recognises the law of comparative advantage in that the arrangement acknowledges the fact that certain activities are performed better by one partner while the other can perform better in another set of activities. Through permitting each partner to focus on their strengths, infrastructure is improved (Caerteling, Halman & Doree, 2008); quality is enhanced and in turn these boost the economic competitiveness as the local innovations become increasingly acceptable to the foreign market. The Price Waterhouse Coopers Report, (*d.u.*) on PPPs stresses that when designed appropriately, PPPs could go a long way in ensuring that the public sector benefits from the private sector's commercial restraint, incentives, experience and expertise. They also enable the public sector to deliver its objectives better and to focus upon its core activities of procuring services, enforcing standards and protecting the public interest".

2.8.2.8 Faster and Increased Project Delivery

PPPs have proven to be reliable agents of speedy project delivery including the so-called "complex capital projects". Such is achieved especially when using finance from the private sector, when it is appropriate to do so (Hellowell *et al*., 2008). This might be due to the fact that private sector finances do not have many protocols compared to state funding. Thus speedy R & D and commercialization can be enhanced through PPPs.

Hellowell *et al*. (2008) however offer a precautionary note which this study finds quite useful. While increased private sector partaking, especially in public service delivery, can be quite advantageous the authors caution that PPP's are not necessarily a universal solution or the sole means to providing quality public services on a value-for-money base. Thus PPPs are generally viewed as one of a myriad means of public service delivery and should never be taken or perceived as replacement for required levels of accountability and proper governance.

2.8.3 Developing a Framework for Creation of PPPs

As noted previously, both developed and developing economies are working towards formulating and sustaining PPPs in their various forms. However, most developing countries have lacked a framework for developing such partnerships. Amongst The economies which have managed to set up some PPPs, not much has been done in terms of assessing how effective such partnerships have been. Thus Critical Success Factors (CSF) have been proposed for formulating PPPs as explained ithe paragraphs that follow.

2.8.3.1 Critical Success Factors (CSF) of PPPs in Developing Economies

With a history of first use "as a management measure" in the 1970s in the context of finance (Boynton & Zmud, 1984), in Information Systems (IS) and project management and then in manufacturing (Mohr and Spekman, 1994; Rockart, 1982 *in* Jefferies, 2006), CSFs are defined by Rowlinson (1999) as "those fundamental issues inherent in the project, which must be maintained in order for a team working to take place in an efficient and effective manner". In fact, in Strategy and Leadership, CSFs (also known as Key Success Factors (KSFs)) have been long described to be the "hottest management buzz words" (Freund, 1988:20). According to Jefferies (2006), CSFs call for everyday consideration and run throughout the project's entire life. Various factors have been identified as critical success factors for PPPs. Table 4.2 below summarizes these and other CSFs for PPPs.

Table 2.4: Critical Success Factors of PPPs (Extracted from various sources)

Author (s)	**Critical Success Factor (s)**
Aarikka-Stenroos, Sandberg & Lehtimäki (2014); Aarikka-Stenroos and Sandberg (2012)	Consistent and justified changes in network relations
Witters *et al.* (2012)	Argue that ICT is necessary to facilitate the formation and operation of virtually every PPP
Martinelli *et al.* (2008); Landry *et al.* (2002)	Informal networks often facilitate more formal relationships that facilitate spinoff and licensing arrangements with established firms
Pollock *et al.* (2007); Rothaermel *et al.* (2007); O'Shea *et al.* (2005); Shane and Stuart (2002)	Composition of the founding team, their collective industry experience, management capability, and knowledge are critical
Zhang (2005)	Need for a workable and efficient procurement protocol
Jefferies *et al.* (2002); Qiao *et al.* (2001); Akintoye *et al.* (2001a)	Available financial market
Qiao *et al.* (2001); Kanter (1999); Zhang *et al.* (1998); Stonehouse *et al.* (1996)	Government involvement by providing guarantees
Qiao *et al.* (2001); Badshah (1998); Frilet (1997)	Good governance
Qiao *et al.* (2001); Zhang *et al.* (1998)	Political support
Qiao *et al.* (2001); Dailami and Klein (1997)	Established and secure economic environment
Qiao *et al.* (2001)	Technology transfer
Qiao *et al.* (2001); Grant (1996)	Equitable risk sharing
EIB (2000)	Sound economic policy
Kanter (1999); Stonehouse *et al.* (1996)	Shared authority between public and private sectors
Kanter (1999); Stonehouse *et al.* (1996)	Commitment/responsibility of public/private sectors
Bennett (1998); Jones *et al.* (1996); Stein (1995)	Favorable legal framework
Frilet (1997)	Social support
Finnerty (1996); Jones *et al.* (1996); Stein (1995)	Well-organized public agency

In support of O'Shea *et al.* (2005) and Shane and Stuart (2002), Rothaermel *et al.* (2007) emphasize that composition of the founding team, their collective industrial experience, comprehension and administration capabilities are all essential. Unfortunately, most of the PPP's in developing economies teams lack these characteristics. Lack of most CSFs in developing economies has been attributed to the continued failure of PPPs.

As can be noted from the summary table, quite a considerable number of studies focus on PPPs success factors. From the summary table, similarities and differences can be established regarding the

various proposed CSFs. Li *et al.* (2005) attempt to rank these CFSs according to their perceived relative importance – the top five CSFs being:

(1) Strong private consortium,

(2) Appropriate risk allocation and risk sharing

(3) Available financial market

(4) Commitment / responsibility of public / private sectors and

(5) Thorough and realistic cost / benefit assessment.

However, despite these CSFs, which have been mostly proven in PPPs of Private Finance Initiatives (PFIs) in developed economies, some problems have been reported with the partnerships, especially in the area of procurement. Pertinent issues include innovation cost restraints, high tendering costs, multifaceted negotiations as well as conflicting objectives likely to emerge from different players in project accomplishment (Akintoye *et al*., 2001).. Government "championing behavior" have also been recorded as dominant in such partnerships (Caerteling, Halman, Johannes, Song, Dorée, André, & Van Der Bij, 2013) and quite often without a ready solution. Some of these challenges can, however, be resolved by ensuring that an appropriate structure is set up for the PPP.

2.7.4 Typical Structure of a PPP Project for Developing Economies

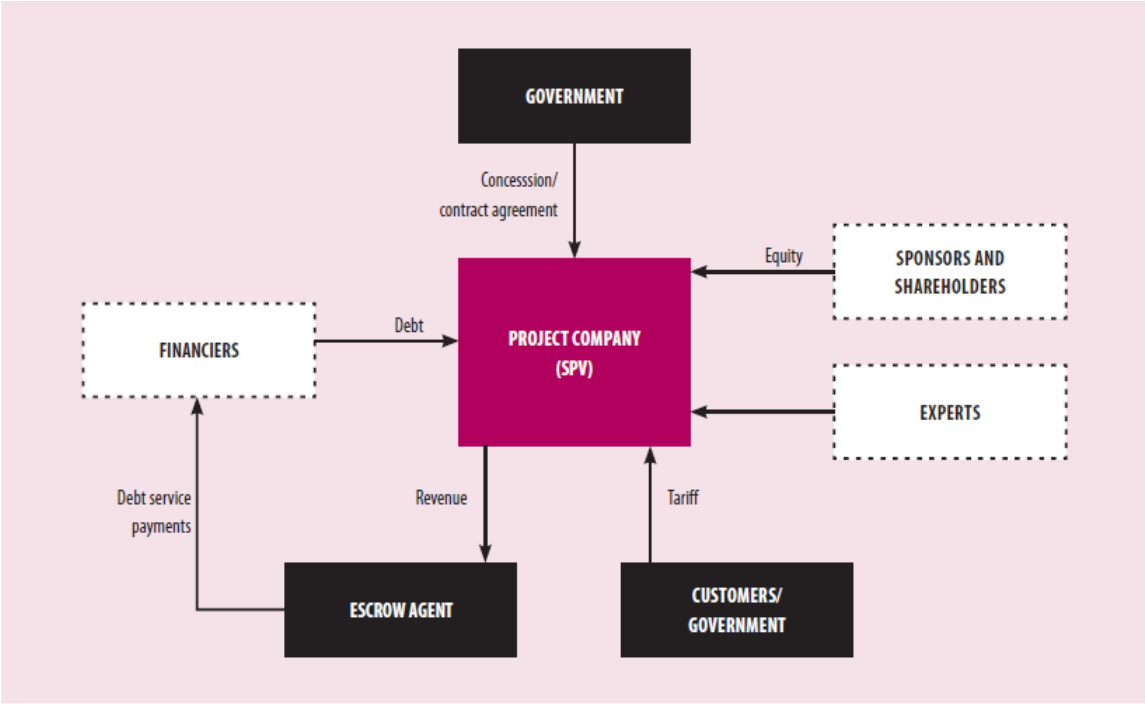

Figure 2.2: Typical Structure of a PPP Project (UN ESCAP, 2011 *in* Witters *et al.*, 2012)

As can be noted from Figure 2.2, there is a need to share risk amongst various participants in the partnership, including the government, financiers and agents. Support from shareholders and various experts is also vital. It is the Special Purpose Vehicle (SPV) that enters into and concludes the contractual agreements with the state, subcontractors (where necessary) and any other relevant stakeholders.

However, it might be quite interesting to note that, while most authors concentrate much on PPPs as a partnership between a private institute and the government (public institute), Greer and Lei (2012) emphasize that research institutes should engage in Collaborative Innovation with Customers (CIC), a concept which the authors argue has not been fully explored and put into practice. From the review of some recent literature on the subject (*e.g.* Lichtenthaler, 2011, 2009; Ojanen & Hallikas, 2009; Elofson & Robinson, 2007; Lichtenthaler & Ernst, 2007), it would seem that a blending of the CIC concept with PPPs could bring some unique but complete results. Although the present study does not necessarily blend these concepts, efforts are made to ensure that the model developed encompasses concepts from both PPP and CIC schools of thought.

2.9 CHAPTER SUMMARY

Grounded upon a review of more than 180 scholarly articles drawn profoundly from other recent literature reviews, the current review establishes that most of the determinant factors for successful commercialization are double sided, i.e. while the presence of one factor could enhance commercialization, the unavailability of the same factor could hinder commercialization. The chapter also s reports that varying perceptual consumer behaviour has an either positive or negative impact on the adoption of new technologies depending on the type of word-of-mouth information that spreads across the market. Regarding PPPs, research shows that collaborative R & D and commercialization activities among industries in most developing economies are still low, although there is a great potential for improvement. The current study also establishes that most literature dwells on PPPs in national service delivery and very little work has been done focusing on TIs' commercialization by PPPs. The next chapter (Chapter 3) sets the theoretical framework from which a conceptual model for this study is derived.

CHAPTER 3

THEORETICAL AND CONCEPTUAL FRAMEWORK

3.1 INTRODUCTION

This chapter presents a theoretical and conceptual framework along with a proposed model of commercialization of technological innovations for developing countries, from which various research propositions are deduced and tested later in Chapters 6 and 7. The framework is primarily based on the findings established in the literature review presented earlier. The chapter explores a number of theories that serve as a foundation to the proposed model, which then provides a framework for the study's research design and later on, data analysis. The succeeding discussion underscores the correlation and influence of these theoretical conceptions relative to the development of the model that also addresses the main research question of the study.

With regards to innovation management studies, Chesbrough (2009, 2003) has noted that even though business models have been mostly applied to the entrepreneurial firms' contexts, such models also add value in appreciating how different firms can "convert technical potential into economic value". Corkindale (2008) emphasizes the need to develop an appropriate business model for commercialization. Three theoretical constructs dominate in innovation commercialization literature and these include commercialization enabling factors, inter-firm commercialization relationships or partnerships (PPPs) and market-based factors (expectations and perceptions). These are the key inputs into the current study's framework put forward for developing economies.

3.2 COMMERCIALIZATION AND *SUCCESSFUL* COMMERCIALIZATION OF TIs OPERATIONALIZED

Based on the commercialization literature reviewed, commercialization of technological innovations is operationalized in this study by espousing the simplified views of Jolly (1997) that commercialization is the introduction of, or offering a new product to the market. Thus the process includes some decisions that define how the new offering is positioned and eventually launched in the market (Hultink *et al.*, 2000, 1997). The definition excludes any R & D activities done prior to launch of the product. Of the several views from different authors, this study operationalized "successful" commercialization as the achievement of a first sale complemented by the continued existence of the

technological innovation on the market (Nerkar & Shane, 2007; Rothaermel *et al.*, 2007; Leitch & Harrison, 2005; Rothaermel & Thursby, 2005).

3.3 CATEGORIZATION OF COMMERCIALIZATION MODELS

The origins of technology commercializing are largely attributed to the work of Bush (1945) in his ground-breaking paper entitled, "As we may think." Bush (1945) talks of basic and applied researches, which should come one after the other before product development, production and eventual diffusion can take place. His contributions are incredibly prominent within the innovation management circles notwithstanding the criticism of his contributions for simplistic arguments drawn from a linear school of thought. However, succeeding studies on technology commercialization are largely built on the same seminal contributions (*e.g.* Rogers, 2003; Jolly, 1997; Rogers, 1995) and this has been the starting point even for other recent commercialization models (*e.g.* Zaidi & Naeem, 2005).

Powers (2003: 28) argues that commercialization "as a topic of inquiry, is still very young and underdeveloped." He goes on to say, "what has been published is largely theoretical as researchers sought to describe and /or understand particular aspects of its practice for which a theory of technology transfer may ultimately take form". This line of thinking might have been true in the past, but literature reviewed by the current study shows that there are two conflicting schools of thoughts on how the commercialization of innovations should progress – the 'Linear Models' (at times referred to as the 'Process Model') and the 'Functional Model', also known as the 'multi-dimensional' schools of thought. In the Linear Models, where Bush (1945) seems to originate from, commercialization is perceived to be a set of some orderly steps or i.e. concept development, followed by prototype development and testing, product development, full production and eventually passing the new product to the market, through relevant departments (Zaidi & Naeem, 2005). In some cases Linear Models consist of corresponding streams of complementary activities undertaken concomitantly so as to maximize the likelihood of successful commercialization. The Linear Models are usually presented as block diagrams, although there are a few exceptions.

However, commercialization has generally been understood, in innovation studies, as the final stage in the linear innovation process beginning with research. This is the case in universities and other institutions of research, in which basic innovation focused linear models are regarded solely as producers of knowledge (Carnegie Mellon University, 2002), then proceed to development and ultimately to commercialization. Proponents of the linear school of thought such as Goldsmith (1995, 2003) note that the commercialization process is a complex entity that only commences "when the

prospects for a technical breakthrough are combined with a potentially attractive market opportunity". Goldsmith (1995) has developed one of the common linear models, commonly known as the "Goldsmith commercialization model' which involves "design, development, manufacturing and marketing". The model also incorporates the need to make some improvements to the new product quality. In an effort to summarize preceding findings, Pellika and Lauronen (2007) note that a number of studies on innovation seem to be in agreement in terms of the commercialization process requirements, which are summarized as:

- Appreciating the needs of the target market;
- Involving customers during the early stages of NPD; and
- Introducing the TI to a market that is deemed to be attractive.

In addition, Chesbrough (2009; 2003) confirms the need for a business model for any firm with an intention to commercialize new technologies – a model that is expressive of the value proposition, identifies the relevant market segment(s), defines the new technology's value chain, a model that specifies the means of revenue generation for the firm based on the value chain assumptions and clearly spells out the strategy that will allow the firm to obtain sustainable competitive advantage.

3.3.1 The Traditional Sequential New Product Development (NPD) Model

With its roots back-dating to the 70's (Rothwell, 1977), the traditional view of NPD modelling demonstrates the sequential stages through which a product is developed and eventually fully commercialized. The process commences with idea generation and goes through various other stages (depending on the specific model type) before the final launch of the product (Cooper & Kleinschmidt, 1995). Perhaps the most widely used model in literature for commercialization of research findings which closely resembles the traditional NPD is the *Stage Gate Model*, propounded by Cooper (1984).

3.3.1.1 The Stage Gate Model

Developed by Cooper (1984: 10) as "a blueprint for managing the new product process from an idea to launching a product in a number of predetermined stages", the model attempts to enhance the effectiveness of the NPD process, every step constitutes a "set of cross-functional and parallel activities" which must be successfully accomplished before acquiring management authorization to proceed to the next stage. The entry to each stage is referred to as "a gate." According to Cooper (1984), the Stage Gate Model has five phases which include: Scoping, Building the Business Case, Development, Testing and Validating and Launching. In his own words, Cooper (1984: 7) defines what each stage entails as follows:

1. *Scoping* – "A quick, preliminary investigation of each project provides inexpensive information by desk research to enable narrowing the number of projects".
2. *Building the Business Case*- "A much more detailed investigation by primary marketing and technical research. The business case must include a product definition, a product justification and a project plan".
3. *Development* – "A detailed design and development of the new product, along with some simple product tests. Also a production plan and a market launch plan are developed".
4. *Testing and Validation* – "Extensive product tests in the marketplace, the lab and the plant.
5. *Launching* – "Beginning of full production, marketing and selling. Market launch, production / operations, distribution, quality assurance". A review of "post-launch" activities is also emphasized at this stage.

The main strength of the *Stage Gate Model* lies in its capability to break through the complex NPD process which facilitates more focused prioritized effort on specific tasks. As postulated by Jolly (1997), one of the traditionalist proponents, commercialization is all about successful performance of different sub-processes, with each process adding some value to the technological innovation. However, a major critique leveled against the approach is that the model is generally sequential, i.e. the model proponents believe that commercialization follows some sequence. Some experts in innovation (*e.g.* Adler, 1999; Goldsmith, 1995) are of the view that NPD should rather "be organized in parallel using loops". Although this traditional perspective of NPD is centered upon "different screening stages and involves only the partial integration of externals (customers) at early stages", Perunovic and Christiansen (2005) also feel that the innovation process has not remained the same with the passage of time. In actual fact, most of the modern day commercialization proponents regard this as a "stepwise" process which may not hold much water in the present day dynamic marketing environment. It can be strongly argued that traditional commercialization models often lack an explanation or even a hint of the reasons for success and failure of different technologies that go through the sequential processes. This also partly explains the reason why some innovations eventually grow to be "industry standards" whereas others fade quickly from the market.

Overall, several critiques have been raised against the "linear logic" of the technology commercialization models. For instance, they reportedly do not sufficiently take care of the "multiple feedback loops that can occur in the new technology commercialization process" (Rothwell, 1977; 1990: 192); they over-simplify NPD adoption and diffusion concepts, focus too much on technological facets, rather than social, behavioural and political (policy) (Schlange, 2009); and they are rhetorically appealing and comprehensive from a policy perspective (Godin, 2005).

Mørk *et al*. (2006) also express disbelief in a fixed product travelling in a linear process to diverse places without changing, as assumed, for instance, in theories of diffusion (Rogers, 1995). In line with relational arguments in science and technology studies, the colleagues argue that movement implies change, as identities and features of any actor or object are shaped in the process of relating to their environment. Thus, in principle, Mørk *et al*. (2006) join the host of other researchers who are against the linear models.

3.3.2 Multidimensional Models

In view of the above limitations of the linear models of commercializing technological innovations, a more multidimensional approach to research commercialization is proposed by diverse authorities. Unlike the Linear Models, these Multidimensional Models (also known as Functional Models) aggregate essential activities and depict relationships between them, without necessarily stipulating steps to be taken or to be followed down a particular pathway. Although they agree that commercialization is indeed a sequential process, multidimensional advocates argue that commercialization naturally requires the innovator to replicate many iterative 'loops' before the process is accomplished successfully. According to Rosa and Rose (2007), multidimensional or functional models do not necessarily set down some steps but, rather, depict some relationships that must be supported in commercialization, as well as the conditions which must be fulfilled so as to maximize the success chances of commercialization. For instance, Lee and Gaertner (1994) developed *The University Technology Commercialization Model*, and later on, Jolly (1997) introduced the *Multi-Faceted Technology Commercialization Process*, among other models. Some of these models are explained briefly below.

3.3.2.1 The University Technology Commercialization Model (Lee & Gaertner, 1994)

In view of the limitations of the linear based models of commercialization of technological innovations, Lee and Gaertner (1994) developed a model, borrowed from the *Stage Gate Model* principles, for the commercialization of research results from universities, as illustrated below:

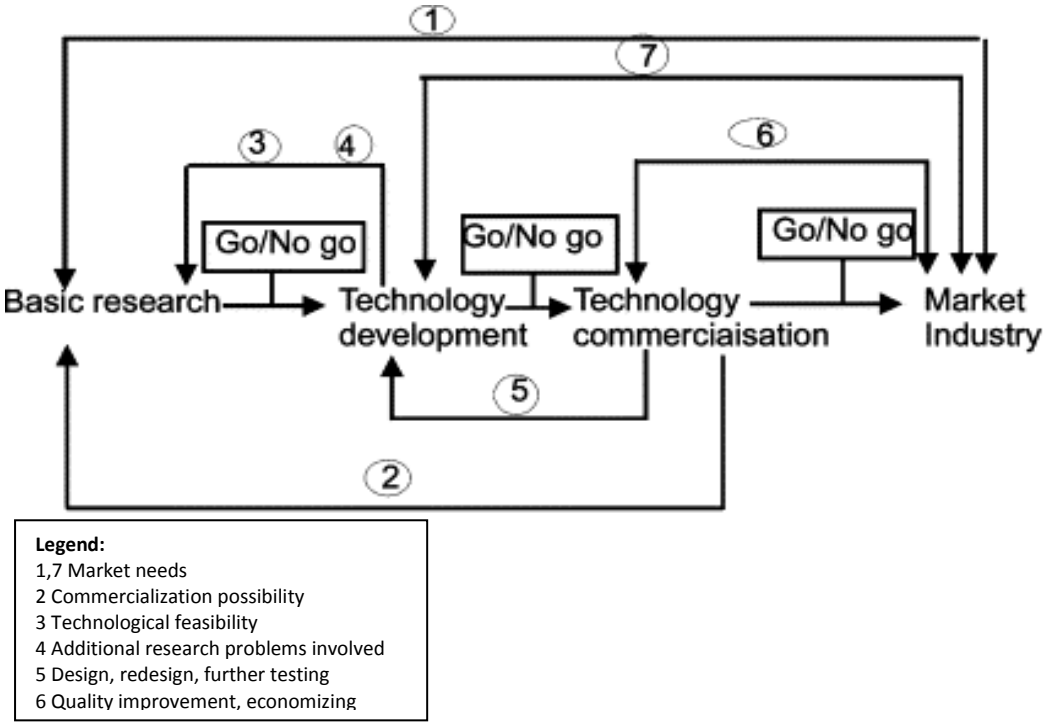

Figure 3.1: The University model of research commercialization (Lee & Gaertner, 1994)

Among the authors assessing the U.S.A *Bayh-Dole Act* and its effects on American institutions are Lee and Gaertner (1994) and much later on, Bremer (2001) and Mowery *et al.* (2001). Despite the later models on university research commercialization, Lee and Gaertner (1994) remain prominent with their multifaceted "Go / No go" phenomenon as the model has been affectionately known. According to Lee and Gaertner (1994), market needs should be established and met i.e. the gap between basic research and market and / or industry (legends 1 & 7) while they established that a commercialization possibility exists between basic research and technology commercialization (2). Legend 3 represents technological feasibility, 4 denotes additional research problems involved while 5 signifies design, redesign, further testing and 6 indicates quality improvements and economizing.

3.3.2.2 The Multi-Faceted Technology Commercialization Process (Jolly, 1997)

In view of the limitations mentioned earlier on, Jolly (1997 proposes a *2 stage-multi faceted process model* whose principles slightly differ from the traditional linear technology innovation commercialization models. Jolly demonstrates the concept of technology commercialization by separating the process into two – the 'main category' i.e. the core activity entrusted with the realization of value of the new product, as well as the 'subcategory', which is basically composed of related activities that involve stakeholders and the satisfaction of those related to each stage.

The *Multi-faceted Model* is described as a continuous process comprising a series of activities and sub-processes referred to as "bridges" which communally link up each of these phases. The stages are so inter-linked that the support activity of one stage may support the core activity in another stage. The five stages of Jolly's commercialization model include: Idea Imaging; Technology Commercialization Possibility Inquiry and Incubating; Product / Process Demonstrating; Promoting Reception/Accumulation; and Sustaining Continuous Commercialization and Long-term Profitability. These are briefly explained and summarized in the table below.

Table 3.1: The Multi-Faceted Technology Commercialization Process Stages (Extracted from Jolly, 1997)

Stage	Brief explanation
(a) Idea Imaging	• The stage involves the judgment of whether the idea is worthwhile to seek commercialization.
(b) Technology Commercialization Possibility Inquiry & Incubating	• It allows one to find out the possibilities and limitations of technology commercialization. • Further in-depth research is conducted on the technology, the research results are integrated into the product and process before commercialization, a prototype is produced or a test stage is performed where connection is made with the initial customers in the market, a stage required for effective demand creation and market related analyses are conducted. • This stage is performed to increase the supplementation and utility of R & D and stimulate more interest from the resource provider and stakeholders.
(c) Product/Process Demonstrating	• This stage is related to product development. • One must recognize what product is wanted by customers, and analyze whether the product incorporating this technology is fulfilling its function. • Product development is a series of activities including product preparation for market introduction from the initial commencement from the design stage, and is a continual process involving preliminary design of the production system, prototype construction, testing and product feasibility analysis, product and production system supplementation, test marketing and validation, production commencement and shipment into the market.
(d) Promoting Reception/Accumulation	• Jolly (1997) notes that 27.5% of new products and process technologies fail due to market factors that are difficult to control, while another 26% are developed with the thought that "there is public demand" but fail because buyers cannot be found or due to insufficiency in marketability. • The strategies in this stage include reception by the market, securing a position in the market enabling adoption by consumers, pricing for early adoption, sales strategy in line with the propensity to purchase, communications for widespread reception etc.
(e) Sustaining continuous commercialization and long-term profitability.	• This involves making post-launch efforts to sustain the continued commercialization of the new product.

3.3.3 Dimensional Model of Commercializing Innovations (Chiesa & Frattini, 2011)

Borrowing literature from innovation management studies, marketing and from diffusion of innovations, Chiesa and Frattini (2011:437) developed a model that demonstrates the influence of and / or the relationships between commercialization decisions and consumer acceptance of especially high technology products, both by "affecting the extent to which the players in the innovation's adoption network support the new product and by affecting post-purchase attitude early adopters develop toward the innovation, and hence the type of word-of-mouth (positive or negative) they disseminate among later adopters." The duo argues that while strategic decisions are considered before developing, launching or introducing the innovation in the market, tactical decisions should cover the major marketing mix variables, i.e. one should understand the operational facets of the new product's launch. This is illustrated below.

Table 3.2: Dimensions of Commercialization Classified (Chiesa & Frattini 2011: 439)

Variable	Description	Type of variable
Timing	– Timing of the innovation's launch on the market – Timing of the innovation's preannouncement – Timing for establishing partnerships and alliances	STRATEGIC VARIABLES
Targeting and positioning	– Target market for the innovation – Market positioning of the innovation	
Inter-firm relationships	– External organizations with which to establish relationships – Terms of the agreements underlying the relationships	
Product	– Configuration of the ''whole product''	TACTICAL VARIABLES
Distribution	– Type of distribution channel for the innovation – Critical functions the distribution channels is expected to perform	
Advertising and promotion	– Types of advertising channels – Type of message conveyed	
Pricing	– Pricing strategy – Pricing of complementary goods and services	

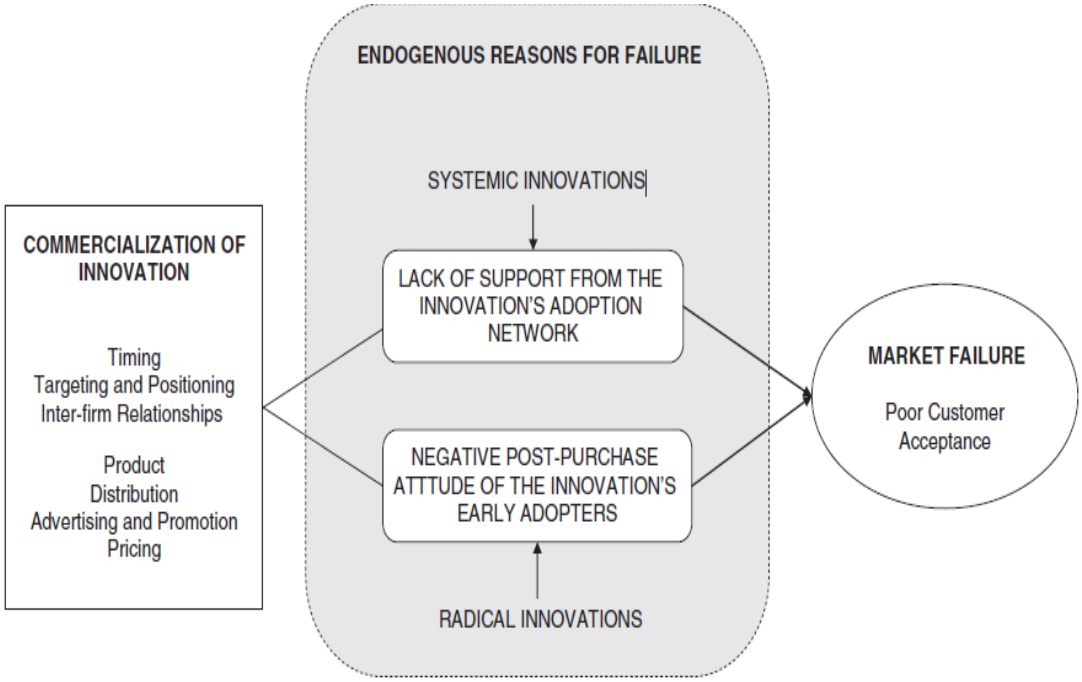

Figure 3.2: Dimensions of Commercialization of Innovations (Chiesa & Frattini, 2011: 439)

Chiesa and Frattini (2011) start by explaining and grouping the variables for their model into tactical and strategic variables, as shown in Table 3.1 above. The authors further group innovations into two main categories: systemic and radical innovations. In their model, the duo argue that while successful commercialization is anchored upon good timing of product launching, targeting and positioning decisions, inter-firm relations as well as proper application of the basic marketing mix variables, it is the "lack of support from the innovation's adoption network" that causes failure, especially for systemic innovations. Early adopters' negative attitude, leading to possible negative word-of-mouth information can lead to failure of radical innovations on the market. The model operationalizes market failure as poor customer acceptance of the new product.

3.4 ENSURING SUSTAINABLE COMMERCIALIZATION AND REALIZING LONG-TERM PROFITABILITY

It can be argued that the means to reaping maximum value from new technological innovations is to ensure long-term commitment or continuity in commercialization efforts of the innovation. The majority of the traditionalist models to commercializing innovations have been also criticized for lacking this requirement in the proposed commercialization processes. However, Jolly's (1997) Multi-faceted Commercialization Model attempts to provide some insights on this through the fifth stage of the model, though not much is said. For instance, the model does not explain much about how the commercialization can be sustained in order to obtain the long-run profits for the firm. Based on this

obvious gap, various authors (*e.g.* Weckowska, 2010; Chandran, 2010; Bianchi, Chiesa & Frattini, 2009; Gorman *et al.*, 2008; Shane, 2004; ARC, 2000) concur that the techniques to achieve sustainable commercialization of innovations include, among many others, patent protection of the innovation, making supported efforts to increase product consumption or consumer spending, obtaining exclusive rights "of core technology to secure long-term profits", continued production of the technology, as well as ensuring continued existence of the "firm established with that technology". It is not surprising to have quite a number of innovation management authors concur on this sustainable commercialization, given that the various commercialization models proposed by numerous modern day researchers appear quite universal, save for a few variations in the scope of the commercialization phases they propose.

While traditionally, commercialization has been taken to be progressive in a linear fashion (Zaidi & Naeem, 2005), it is now widely acknowledged that it is undoubtedly not as "sequential and orderly" as it was thought to be; but is a relatively slow and expensive process. The firm's capability "to commercialize technology"; to shift the technological innovation from an idea to conception right through to market introduction in a quick and efficient manner remains fundamental, especially in view of an ever-changing technological commercial environment. This applies in both developed and developing economies. Within these common trends is the ever-increasing spread of technology and the rapidity with which new technologies are rendering the preceding ones obsolete.

Further review of literature reveals that although many studies have been accomplished from diverse schools of thought with an intention to find the most suitable model of commercializing TIs, the "most appropriate" model still has not yet been precisely established. However, one way of discovering the 'close to appropriate' solution to this gap is through examining and considering the common areas and criteria emphasized in all models – a strategy utilized by the current study. Though the literature is inconclusive as to which of the commercialization models is the best, it must be stressed that realizing the potential benefits of innovation requires an effective commercialization process (Sirking & Andrew, 2003). Although the current study borrows much from the theory of Chiesa and Frattini (2011), some variables have also been borrowed from various other foregoing commercialization models.

The abovementioned and other commercialization models and their diverse contributions to the current study can be summarized as follows:

Table 3.3: Summary of Commercialization Models and Their Contribution to the Study

Model	Author (s)	Model's Brief Description and Application	Model's Role in the Discourse
Dimensional Model of Commercializing Innovations	Chiesa and Frattini (2011)	Borrowing literature from innovation management studies, marketing and from diffusion of innovations, the model denotes how and the extent to which commercialization decisions influence new high-tech product acceptance by consumers. Model depicts the extent to which the players in the "innovation's adoption network" support the new product and by affecting post-purchase attitude by early adopters develop toward the innovation, and hence the type of word-of-mouth these early adopters disseminate among later adopters."	The model posits that successful commercialization would be anchored upon good launch timing, positioning decisions, market targeting, inter-firm relations and proper application of the basic marketing mix variables as well as market perceptions of especially early adopters.
The Functional Model	Industry Canada (IC) (2006)	The model describes various component parts of the commercialization process and "their relationships to each other, without overlaying them upon a linear, time-based process" (Ferguson, 2007, 2011).	The model proponents believe ideation can take place at any phase of the commercialization process and that the process is an iterative one i.e. it goes back and forth towards refinement, eventually leading to successful commercialization. The model proposers also posit that "ideas can include all-new products or services, or incremental enhancements of existing ones, or new applications for existing products or services, and the steps necessary to adapt these to a new marketplace" (IC, 2006:4).
The Carnegie Mellon Innovation Transfer Process Model (The Interactive Model)	Carnegie Mellon University (2002)	With three basic steps, the model is developed to accommodate mentors and experts appropriate to the proposed commercialization.	Its intent is to help a university researcher determine the commercial prospects for an idea by involving financial, technology and marketing experts at an early stage, developing the idea and then presenting it to potential licensees or investors. If the process does not result in a successful commercialization, the IP is then licensed to the innovator.
The Multi-Faceted Technology Commercialization Process	Jolly (1997)	The model explains the concept of technology commercialization by separating the process into two – "the 'main category', which is the core activity realizing the value of the new technology along with the 'subcategory', which is a	The model emphasizes the need for not only test marketing, but also promoting the new product, thereby enhancing the product's reception, and in turn, accumulating and sustaining continuous commercialization.

		process of related activities involving stakeholders to satisfy those related to each stage and to accomplish the aims".	
The Stage Gate Model	Cooper (1996)	-The model presents a sequential process for managing the NPD process from idea generation right through to product launch through a number of prearranged stages (the "gates") - Scoping, Building the Business Case, Development, Testing and Validating, Launching.	It also provides the essence of test-marketing (Testing and Validating) as a key determinant for commercialization. The model is fundamentally "sequential" and has been extensively criticized for that (*e.g.* Schlange, 2009; Adler, 1999), thus the model does not add much value to the current study.
The Goldsmith Commercialization Model	Goldsmith (1995)	This model assimilates the technical factors, market-related and business elements of commercialization into a matrix of concurrent and sequential activities and decision points	The model does not add much value as it is more of a 'check list,' describing simultaneous technical, market and business activity at six different stages.
The Traditional Sequential New Product Development (NPD) Model	Cooper and Kleinschmidt (1995)	The model presents a commercialization processes that commences with ideation (idea generation), goes through various other stages before reaching the "commercial launch" stage. The model applies in environments that are assumed to be constant	It provides the essence of test-marketing as a key determinant for commercialization. The model, however, entails part integration of customers
The University Technology Commercialization Model	Lee and Gaertner (1994)	The complex "Go - No go" phenomenon, developed for commercialization of technological innovations coming through academic / university research	The model asserts that market needs should be established, and that there should be technological feasibility in terms of design and quality.

Source: ***Compiled by the researcher***

None of the models described thus far are known to offer a guarantee for commercialization success. Instead, they simply depict the key elements of the commercialization process, the relationships between various variables, and the measures and provisions any discreet investor would make in establishing a business that deals with new products or new services. The models do not necessarily predict nor do they guarantee any outcomes. They primarily recognize the need to generate or seek out the appropriate conditions necessary to achieve success in commercialization of new products. However, the majority of the models does not offer an explicit description of the specific circumstances necessary for successful commercialization, nor the specific individual nor organizational qualities and attributes necessary for guaranteed commercial success. Thus the current research is of the view that the value of the preceding models discussed could certainly be improved

by the inclusion of some specific predictor variables which will help model users to at least envisage successful commercialization if certain conditions are met.

3.5 THE CONCEPTUAL FRAMEWORK: MODEL OF COMMERCIALIZING TIs IN DEVELOPING ECONOMIES

In developing a model for commercializing TIs for developing economies, this study treats successful commercialization as the achievement of a first sale supported by the continued existence of the technological innovation on the market. Though a number of past studies have been carried out elsewhere on innovations commercialization (*e.g.* Frattini *et al.*, 2012; Chiesa & Frattini, 2011; Gans *et al.*, 2007; Shane, 2004; Mowery *et al.*, 2004; ARC, 2000; Jolly, 1997; Lee & Gaertner, 1994), the studies do not (adequately) reflect on the peculiarities of third-world countries' contexts. This limitation is partially addressed by Chandran (2010) but his study focuses more on emerging rather than developing economies. Moreover, most of the past studies omit the views of the customers despite their critical role, as cited by Greer and Lei (2012), thereby rendering the results incomplete – gaps which this study intends to fill. The study thus contributes through the identification of ways to enhance the effectiveness of the commercialization process in developing economies such as Zimbabwe. This framework (Figure 3.3) embodies a conceptual assimilation of elements found in the technological innovations commercialization literature. The framework identifies the most imperative factors facilitating and hindering (successful) commercialization of technological breakthroughs in Zimbabwe, with the role of PPPs taking centre stage. More specifically, this study is grounded using an integrative theoretical framework incorporating essential elements of the Dimensional view of commercialization of innovations (Chiesa & Frattini, 2011).

Thus based on the extant literature reviewed above, the study proposes the following conceptual framework from which several hypotheses are drawn and later tested.

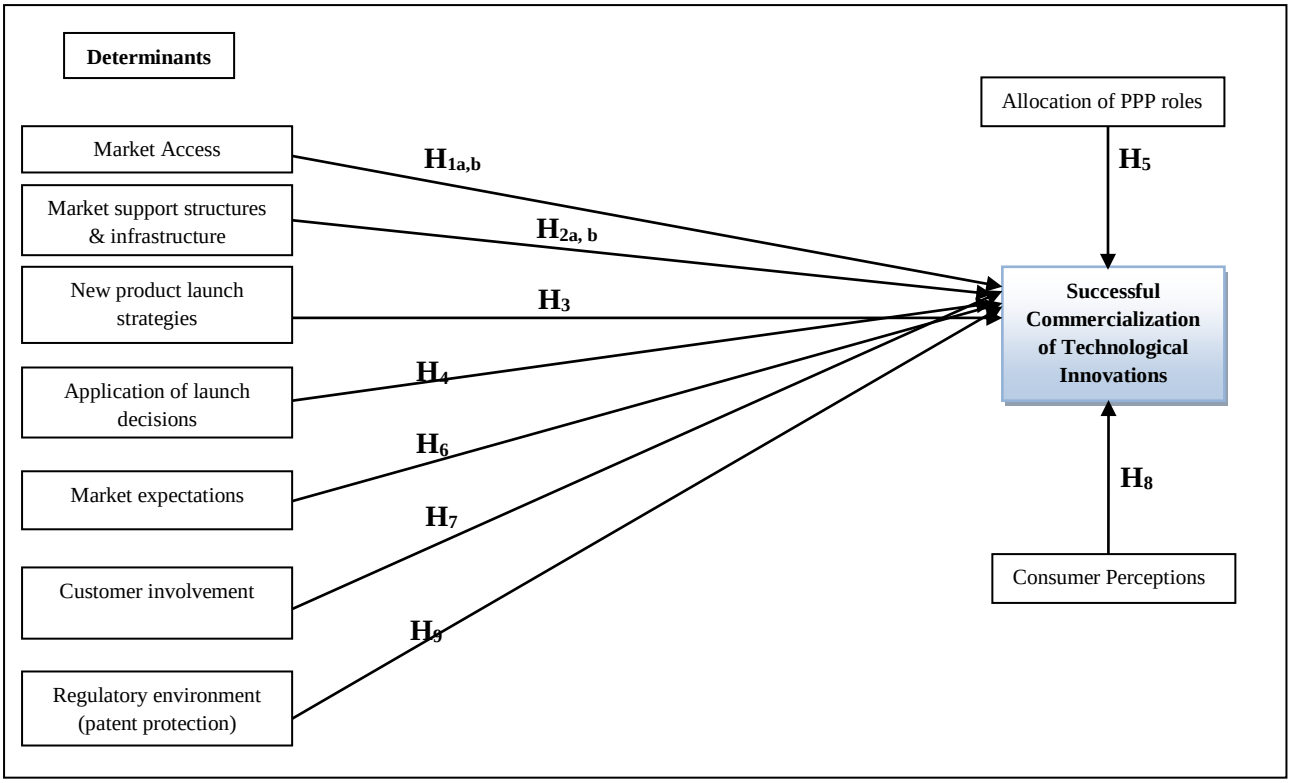

Figure 3.3: The Proposed Conceptual Framework for Commercializing TIs in Developing Economies

In modelling the determinants of successful commercialization, this study draws upon previous research on factors affecting the commercialization process, studies done by Frattini *et al.* (2012), Greer and Lei (2012), Chiesa and Frattini (2011), Chandran (2010), Gans *et al.* (2007), Shane (2004), Mowery *et al.* (2004), ARC (2000), Jolly (1997), Lee and Gaertner (1994), March (1991) and others. The model also blends in the role of PPPs whose theory is borrowed from Chandran (2010), Tomsk (2006), Pollock *et al.* (2007) and Qiao *et al.* (2001), among other seminal authors.

Figure 3.3 above illustrates how diverse commercialization determinants can impact the success of commercialization efforts, including the role of PPPs, backed up by the impact of customer perceptions on commercializing technological innovations. It is possible that the relative importance of the determinants may differ vis-à-vis their contribution towards ensuring successful commercialization of innovations. Various hypotheses are thus developed from the framework to test the various relationships indicated.

3.6 PROPOSED HYPOTHESES

Based on literature and on the conceptual framework illustrated above, numerous hypotheses are formulated to tackle the main research question. The model will be modified, refined and finalized based upon the results of the Zimbabwean research institutes' survey planned as part of the author's research.

The success of any commercialization effort is largely dependent on a wide range of determinant factors, one of which includes access to the market. Though the market access variable has not claimed a considerable amount of literature, the ability for consumers and / or potential consumers to form pre-experience comparison and / or judgment for an unfamiliar innovation can depend on how accessible the new product might be. However, there is likely to be an association between the ratings of market access and the value placed on this determinant by customers. This justifies the first two hypotheses ($\boldsymbol{H_{1a}}$ and $\boldsymbol{H_{1b}}$) below.

H_{1a}: Commercialization success of a technological innovation depends on market access.

H_{1b}: There is an association between the rating of market access and the value placed on the determinant by customers.

H_{2a}: Commercial performance of a new technology is dependent upon market support structures and infrastructure.

H_{2b}: There is a positive association between the extent of failure by government to provide technological infrastructure and the agreement with government giving adequate support for commercialization.

The above hypotheses are developed to establish the relationship between successful commercialization of technological innovations and market support structures and infrastructure. Zaidi and Naeem (2000) identify weak and / or inadequate technological infrastructure as one of the organizational-policy related factors that hinders effective commercialization in Pakistan. Could it be that the same could still be happening in Zimbabwe? Thus a follow-up hypothesis tests if any association exists between the extent of hindrance of failure by government to provide technological infrastructure and the agreement with government giving adequate support for commercialization.

H_3: Successful commercialization of a Technological Innovation (TI) depends on the new product's launch strategies.

Hypothesis $\boldsymbol{H_3}$ above is developed to explain the relationship between successful commercialization and the launch strategy used by the research institute. Hartley (2005) and Schilling (2005) add weight

to various launch strategy and tactics proponents (*e.g.* Hultink *et al.*, 2000; Di Benedetto, 1999; Hultink *et al.*, 1997) in substantiating that, in spite of being functionally and technically advanced compared to competing technological innovations, successful commercialization can still be flawed due to poor launch strategy.

H_4: Successful acceptance of a TI depends on the proper implementation of market introduction (launch) decisions (i.e. decisions pertaining to launch timing, targeting and positioning, awareness).

Past studies have been criticized for fundamentally overlooking the impact of decisive commercialization choices i.e. launch decisions (such as choices on timing and positioning as well as distribution channel choices) on the technological innovation's market performance. However, Garrido and Polo-Redondo (2005), in support of Hultink and Robben (1999), write on how tactical launch (marketing and commercialization) decisions influence the market performance of a new product. More recent literature in the form of Chiesa and Frattini (2011) attempts to provide an understanding of what they term, *"the anatomy of a launch strategy"* and the duo investigates the correlation between particular launch decision choices and market success of high-tech innovations. The current model also hypothesizes the same though with a view that such decisions be acted upon through combined efforts of PPPs.

H_5: Commercialization success largely depends on the appropriate allocation PPP roles.

Research shows that collaborative R & D and Commercialization (R & D-C) activities among industries in most developing economies are still at grassroots level although there is great potential for improvement. Through a review on literature on PPPs, this study also establishes that most literature dwells on PPPs in national service delivery (Witters *et al.*, 2012; Hellowell *et al*., 2008) and very little work focuses on TIs' commercialization PPPs. Thus $\boldsymbol{H_5}$ attempts to explain the correlation between PPPs and successful commercialization, with particular emphasis on the partners' ability to play their appropriate roles.

H_6: Good acceptance of a new product depends on understanding market expectations.

In support of various past studies (*e.g.* Antioko & Kleijnen, 2010; Nerkar & Shane, 2007; Pollock *et al.*, 2007; Rothamel *et al.*, 2007) $\boldsymbol{H_6}$ simply correlates successful commercialization with the fulfillment of market expectations. For instance, Nerkar and Shane (2007) empirically examine the technological innovations' attributes and their influence on commercialization, while Pellika and Lauronen (2007) posit that there is need to understand market expectations.

H_7: Successful commercialization is most likely to be achieved through customer involvement

Through an extensive review of literature from innovation, management, strategy and marketing disciplines, Greer and Lei (2012) place an emphasis on how firms can potentially engage in CIC at both individual and business levels. The review, which is anchored in the conceptual framework from various existing models (*e.g.* Ojanen & Hallikas, 2009; Etgar, 2008; Payne *et al.,* 2008) simply relies on different pieces of literature, thus the current study tests this relationship.

H_8: Successful commercialization of a new product depends on the perceptions consumers or potential consumers hold of it.

Chiesa and Frattini (2011) argue that customer acceptance is one of the key commercialization success or failure dimensions that reflect the TI's uptake in the market. The customer acceptance by current and successive generations is, in turn, affected by the customer perceptions of the innovation.

H_9: Successful commercialization can be positively influenced by the regulatory environment such as patent protection.

Market protection or lack thereof is said to have an impact on the commercialization of technological innovations (Zaidi & Naeem, 2000). The U.S.A *Bayh-Dole Act of 1980*, a government policy for stimulating commercialization, features prominently (Weckowska, 2010; Mowery. 2004), though it has received mixed reactions on its impact. Thus H_9 tests if the commercial performance of a new product can be influenced by the regulatory environment such as patent protection. In this case, patent protection is taken to represent the legal or regulatory environment of commercializing technological innovations.

3.7 CHAPTER SUMMARY

This chapter has presents the theoretical and conceptual framework associated with the current study based on past research. Borrowing from other past model contributions, a model of commercializing technological innovations in developing economies has been developed. The model has two dominant theoretical concepts, successful commercialization determinants and PPPs around which various hypotheses have been developed to address the research question. The following chapter discusses the methodology employed for the study.

CHAPTER 4

RESEARCH AND COMMERCIALIZATION POLICY IN ZIMBABWE

4.1 INTRODUCTION

Indeed, policy-makers in most developed, emerging and developing economies put forward innovation, Research and Development (R & D) and commercialization schema as their strategy focal point in order to augment their economic performance (Chandran, 2010; 2008). As noted in the Science and Technology Policy documents (2009, 2002), Zimbabwe follows the same strategic pathway but some irregularities still continue to prevail. Although the Zimbabwean economy evolved and progressed post-independence era, the resource availability and low-cost labor key drivers were obscured by the political and socio-economic crisis that hit the country beginning around 2006. Nevertheless, the nation, through relevant Ministries, has been documenting policy issues related to innovation development and commercialization.

Zimbabwe's efforts to move towards a knowledge and innovation-based, self sustained economy have been evident through the creation of various technology centres including the Nanotechnology Centre commissioned in Harare towards end of 2013. However, such a move on its own is inadequate. It is necessary that research institutes such as this commissioned centre pursue efforts to bring forward the research results to the market for market adoption and consumption. Thus the ultimate goal of researchers should be to ultimately land their output in the hands of the users, as put forth by Chandran (2010). Indeed, the role of getting innovative ideas to the marketplace now rests more on the shoulders of multi-players – the state, research institutes as well as industry. Given this background, this chapter critically analyses the literature surrounding the role of the government and policy-related issues in technological innovation (TI) development and commercialization.

4.2 THE ROLE OF THE GOVERNMENT IN COMMERCIALIZING TIs

According to Link *et al.* (2010), governments support firms' technological innovations through providing technology infrastructures, public goods and services. The same authors argue that governments moreover have a duty to provide services that influence the TIs by inspiring the private sector R & D and facilitating technology transfer and commercialization. Governments in developed economies have actively pursued policies aimed at aiding the progress of technology transfer and

commercialization. For example, Table 4.1 below summarizes some of these policies and the resultant effect.

Table 4:1: Government Policy Examples and Their Effects

Policy / Act	**Intended Purpose**	**Resultant Effect**
The Bayh-Dole Act of 1980	Legislated to allow USA universities and small businesses to appropriate the ownership of inventions resulting from federal government-funded research	The technology licensing has expanded remarkably in the US since the Bayh-Dole Act of 1980 (Kang *et al.*, 2011)
The Small Business Innovation Development Act of 1982	Legislated to promote the private sector's commercialization	Has indeed promoted the private sector's commercialization (Link *et al.*,2010)
The Small Business Innovation Research (SBIR) program	Developed with an objective of providing funding to private sector R & D ventures in a move to accomplish the government's objectives of SME development	The programme encouraged small firms in the USA and helped complement the results of the federal R & D efforts.
Technology Transfer Commercialization Act of 2000	Put in place to facilitate easy innovation licensing by various federal agencies	The intended objective was fairly achieved.
Korean law on Facilitate Technology Transfer of 2000; passed in to the Facilitate Technology Transfer and Commercialization Act of 2006	Legislated to provide the infrastructure and to smooth technology transfer (TT) processes and commercialization of the national R & D outputs	The Korean Government, through the Ministry of Knowledge Economy has supported the firms to facilitate their technology transfer and commercialization even though the level of technology commercialization is still very low.

Source: ***Compiled by researcher***

4.3 HISTORICAL OVERVIEW OF RESEARCH AND COMMERCIALIZATION POLICIES IN ZIMBABWE

Just like in Malaysia (Chandran, 2010), the science and technology progression in Zimbabwe has gone through different phases. The origins of the research commercialization strategy can be traced

back to the promulgation of the Research Act in 1986 and the subsequent creation of institutions like the Scientific and Industrial Research and Development Centre (SIRDC).

4.3.1 The Research Council of Zimbabwe (RCZ) as a Regulator

In 1988 the government set up a body to promote research, science and technology development. The body, Research Council of Zimbabwe (RCZ), was mandated with the "enhancement of scientific and technological capability through cooperative activities among the scientific and industrial community in Zimbabwe". According to its mission statement (RCZ, 2014), "the research council establishes and maintains links with professional bodies and centers of excellence to enhance its role as a facilitator of national and international collaboration in science and technology. The RCZ is a statutory body established in terms of the Research Act of 1986. It is mandated to promote, direct, supervise and co-ordinate research. One major function of RCZ is advising Government on issues of research for sustainable development. RCZ also provides an exceptional forum for interaction and discussion for the mutual benefit of Government, academia and industrialists. It is an established conduit for financial and administrative support for collaborative research among research institutes and councils. RCZ organises biennial symposia and produces proceedings thereof" (Source: *Extracts from RCZ Mission, Vision and Statement of Values*).

"RCZ's role is that of a catalyst, having identified broad areas of concern, it consults and brings together relevant experts to define a programme of work and to seek sources of funds. The RCZ establishes and maintains links with professional bodies and centres of excellence to enhance the quality of its role as a facilitator of national and international collaboration. Collaborative linkages with organisations such as The Academy of Sciences for the Developing World (TWAS), International Council for Science (ICSU), United Nations Programmes and the ICSU Regional Office for Africa keep the RCZ abreast with international developments" (RCZ, 2014: Homepage).

Since the establishment of RCZ, a number of research institutes have been set in the areas of health, building technology and chemical engineering, but the majority of these institutes were agriculture-orientated. All of these operated under the governance of the RCZ but with fluid policies, or rather with no clear policy in place. This largely affected the commercialization of Zimbabwe's TIs since much focus was placed on development, at the expense of marketization of the new products.

4.3.2 Science and Technology (S & T) Policy Launch (2002)

Prior to the Science and Technology (S & T) Policy launch, the Government of Zimbabwe (GoZ) noted with great concern that, "while there are many institutions involved in science and technology,

particularly in Research and Development in the country, most of them are pursuing R & D focused on personal or private institutional interests and not from the point of view of a collective national interest" (MSTD, 2002). The Government was thus faced with an enormous task to tie together all "scattered expertise and sectional interests", and harmonize them for the encouragement and accomplishment of nationwide interests.

Zimbabwe thus officially instigated the national Science and Technology (S & T) policy document in April 2002. According to the policy document (STP, 2002: 3), "the overall S &T policy objective is to promote national scientific and technological self-reliance…. The policy suggests that this can be achieved by stimulating the generation of scientific and technological capabilities in all sectors of the economy. The institutional arrangements for effective monitoring, coordination and direction of R & D should be strengthened. The S & T policy strongly recommends the promotion of R & D financing mechanisms that ensure adequate support for research of national importance".

GoZ has, among other things, established the Research and Development and Commercialization of Innovations Fund in terms of section 30 of the Financial Management Act (Chap 22:03) in order to: Support the identification, development and promotion of Research and Development and Commercialization of Innovations in Zimbabwe. Fund research / innovation projects carried out by individuals, public and private research institutes and companies in the process inculcate a culture of research and development and innovation in Zimbabwe and fund the transfer, adoption and adaptation of technologies or innovations from inside and outside Zimbabwe. Some efforts have been made in attempting to fund the commercialization of research and development and innovations outcomes in Zimbabwe, but these have not reaped the much puffed up result.

4.3.3 The Innovation Commercialization Fund (2005)

The policy was revised in 2005, and this saw the commissioning of the Innovation Commercialization Fund (2005) and a further revision post-economic crisis (2007 – 8) saw the creation of the department specifically set up for commercialization (2009).

4.3.4 Creation of the Commercialization of Research Department (CRD), (2009)

The commensuration of the Government of National Unity (GNU) saw the emergence of a new Minister for Science and Technology Development (MSTD) and the creation of the CRD department which has a role to facilitate:

I. Rapid sustained industrialization through the commercialization of R & D results across all sectors through:

- Identification of key players to uptake R & D results
- Coordination of initiatives to promote the rapid commercialization of R & D outcomes

II. Policy guidance with respect to innovations, inventions and the commercialization process. For example:
    - Innovation and Commercialization Fund (ICF)
    - Assistance in patenting
    - Commercialization standards and guidelines
III. Align commercialization of R & D outcomes consistent with sector based national priorities.

4.3.5 From the year 2010 up to date

Pursuant to the desire to develop and deploy science and technology, in July 2002 the Government of Zimbabwe (GoZ) adopted the National Science and Technology Policy in recognition of the critical function played by science and technology in the social and economic (socio-economic) development of the nation. One of the key aspects on which the achievement of the policy rests is the identification, development, promotion and financing of scientific research, inventions and innovations of national importance. Currently the MSTD is in the process of making consultations on the proposed new Science and Technology Policy.

Despite considerable numbers of innovations from different active research institutes in Zimbabwe, literature indicates that commercialization of technological innovations in the country is still at grassroots levels. A snap survey by the Ministry of Science and Technology Development (MSTD), (2010) details some of the constraints on the commercialization processes in the country. Some of the key points from the report include:

4.3.5.1 Internal institutional arrangements

- Absence of an effective integrated national system of innovation;
- Absence of incentives for R & D;
- Limited and unpredictable financing arrangements; and
- Unclear innovation channels from idea generation to commercial products.

4.3.5.2 Institutional arrangements

- Absence of formal research cooperation agreements between and among R & D institutions;
- Alignment of R & D priorities vs. national focus.

4.3.5.3 Invisibility of R&D outcomes

- R & D initiatives are not properly marketed or not commercialized at all;
- Researchers often focus on academic excellence and not commercialization of their R&D outputs for economic development;
- No techno-preneurship ventures driven by the researchers;
- Current Educational curriculum not pro-business (techno-preneurship).

4.3.5.4 Financing of R&D

- R&D time consuming hence does not attract funding;
- Ongoing R&D not fully recognized & not aligned to national priorities;
- Completed R&D not directly used as a basis of new products and industries
- Institutional Commercialization Fund – not adequately financed to stir up new entrepreneur ventures.

4.3.5.5 Limited R&D Infrastructure

- 'Brain drain' and run down R & D facilities for example SIRDC, Universities and research institutes run by both private and public sector
- Poorly financed R & D institutions (public and private);
- Absence of a strategic policy defining the continuum from human resources development to technology development and industrial/economic growth continued right through to commercialization.

4.3.5.6 Incentives for R&D

- A key driver behind most successful economies;
- Reposition initiatives for decision makers in Zimbabwe;
- An attractive field to venture into.

4.4 INSTITUTIONAL ROLE AND THE ZIMBABWEAN SCENARIO

The effective role of institutions in closing the gap between laboratory breakthroughs and commercialization should never be undermined. This has been the secret behind the success of the Japanese and the Chinese, for instance, in the cases of Industrial Technology Research Institute (ITRI, Taiwan) and TAMA Industrial Vitalization Associations in Japan (Kodama, 1995).

As previously stated, since independence (1980) and following the establishment of the RCZ, Zimbabwe has managed to establish a number of research institutes. These are outlined in the section that follows.

4.4.1 Zimbabwe's Scientific and Industrial Research and Development Centre (SIRDC) and its in-house Institutes

This is the largest integrated research centre in Zimbabwe. Organized in 1993, SIRDC was established through a Parliamentary Act. "The centre provides technological solutions for sustainable development through reduction to practice of developed products and processes. As a consequence of this thrust SIRDC has commercialized some of its products through Sirtech Investments (Pvt) Ltd. SIRDC comprises twelve institutes whose activities can be grouped broadly to cover biotechnology, electronics, energy technology, environment and remote sensing, building construction, material science, metallurgy, information and communication technology, and metrology" (SIRDC website, 2014). The specific in-house institutes that fall under SIRDC are:

- ✓ Biotechnology Research Institute
- ✓ Building Technology Institute
- ✓ Electronics & Communications Institute
- ✓ Energy Technology Institute
- ✓ Environmental Sciences Institute
- ✓ Food & Biomedical Technology Institute
- ✓ Geo-information & Remote Sensing Institute
- ✓ Informatics Institute
- ✓ Metallurgical Research Institute
- ✓ National Metrology Institute
- ✓ Polymer Sciences Institute
- ✓ Production Engineering Institute

SIRDC also administers the Food and Nutrition Council (FNC), and the Technological and Commercial Information Promotion System (TIPS), which complement the Centre's activities (SIRDC, 2014).

Other public research institutes established include the Tobacco Research Board (TRB), Kutsaga Research Institute, Agricultural Engineering Institute (AEI), University of Zimbabwe (UZ) Research Institutes and other state universities and Polytechnic colleges, Harare Institute of Technology (HIT), The Blair Research Laboratory (BRL), Henderson Research Station (HRS) and Cotton Research Institute (CRI), among others (RCZ Research Institutes' Database, 2013). On the private front, a number of players have actively taken part; these include Pedastock Investments, Taisek Engineering, the Institute of Technology, various seed making institutions and various other players.

4.5 CHAPTER SUMMARY

Chandran *et al.,* (2009) re-affirms that it remains the state's role to harmonize and provide "external institutional support" that is central, especially in the case of developing economies akin to Zimbabwe. Such support, however, has been faced with the challenge of being deprived of some other structures of coordinating agencies especially in form of private players (Chandran, 2009) in order to blend the existing systems. What are the real issues behind this? What else is causing the gap between the laboratory and the market in Zimbabwe? What about the government partnering with the private players (PPPs)? Such are the questions that this study addresses with a view to provide a framework for possible policy adjustments.

This chapter has explored the up to date state of R & D and commercialization policies, the existing research institutes and the Zimbabwean government's efforts made in the sphere of innovation commercialization. Guided upon principles already set by other recent studies, the study provides some invaluable insights on the commercialization challenges and issues being faced by developing countries, which are quite diverse from those of the developed world. The following chapter explores the study's methodology, i.e. how the study was carried out.

CHAPTER 5

RESEARCH METHODOLOGY

5.1 INTRODUCTION

This methodology chapter articulates how the study was carried out in attempting to address the research question and develop an understanding of the determinants of technological innovations' commercialization. The chapter presents, amongst other things, the research design, research paradigm, research strategy, population, sample, and sampling procedures and administration of the research instruments adopted by the researcher and the justification(s) thereof.

5.2 RESEARCH DESIGN

Guided by Kalaian (2008), the research design acted as the study's structure or 'blueprint' for fulfilling the research objectives as well as addressing the research questions. For this study, the researcher utilized a mixed-research design. Specifically, the study used the descriptive design as an extension of exploratory studies. While the study was mainly descriptive, it was also partly exploratory hence the study was *'descripto-exploratory*.' From the exploratory perspective, the researcher intended to establish what was really happening (Robson, 2002) i.e. what has been causing innovations' failure to sail through (successfully) on the market. This indeed, as Saunders *et al.* (2009) point out, helped clarify the researcher's understanding of the research problem. Descriptive design was used mainly to portray an accurate profile of the *status quo* so as to have a clear picture of the phenomena. Conclusions were then drawn from both qualitative and quantitative data description.

5.2.1 Mixed-Research Design

Mixed methodology is increasingly becoming recognised primarily, for its "ability to bring multiple points of view to research, riding on the advantage of the strengths of each of the different strategies used to explain or resolve complex phenomena or results" (Takhar & Chitakunye, 2012: 914 *in* Saruchera & Chitakunye, 2013). Using this approach, methods were intentionally mixed for purposes of triangulation, enhancing data validity, complementarity (Pinto, 2010; Brannen, 2009; Manfred, 2008), value diversity as well as for initiation purposes, i.e. "generating new insights in evaluation findings through results from the different methods that diverge and thus call for reconciliation via further analysis, reframing, or some other shift in perspective" (Greene, 2005:2). As Creswell (2010) argues in his video recording, by using mixed methods approaches and integrating the two approaches

to data collection, quantitative and qualitative, the researcher managed to develop a more complete understanding of the research problem than what each method would yield separately.

Furthermore, the researcher adopted multiple methodology design because empirically, it has been clearly established that mixed methods are both "feasible and central to understanding of research and technology commercialization" (Markman *et al*., 2008: 1419), and this indeed resembled this study. Table 5.1 below justifies the multiple data sources used in collecting data for the study. These sources were used simultaneously in a concurrent style.

Table 5.1: Rationalization for using multiple data sources for the study

OBJECTIVE	MULTIPLE DATA SOURCES
To comprehend the research problem and the nature of the study i.e. technological innovation commercialization challenges in Zimbabwe	✓ A review of Published Material (Secondary Data Review)
To investigate factors facilitating and inhibiting successful commercialization of innovations in Zimbabwe's private and public research institutes.	✓ Self-administered customer questionnaires (260) ✓ Research institutes staff self-administered questionnaires (94)
To authenticate the study's research problem and get research institutes operational insights	✓ Key informant interviews with a private and a Public Research Institute (2).
To assess customer perceptions on the state of innovations commercialization in Zimbabwe vis-à-vis their innovation expectations	✓ Self-administered customer questionnaires
To explore the role of Private-Public Partnerships (PPP's) in ensuring successful Research and Development, and Commercialization (R & D-C) of research outcomes	✓ In-depth interviews with institutes (6)
To develop a roadmap as an intervention tool in policy-making	✓ "Success story" reviews from literature ✓ A blend of all methods above

5.3 RESEARCH PARADIGM / PHILOSOPHY

On one end, the study was approached from an interpretive perspective since there were diverse realities that were to be established and they all had an impact on either the "success" or "failure" of innovations' commercialization in Zimbabwe's research institutes. The researcher believed that the determinants were mostly a result of interaction (or lack of interaction) of the major participants involved in the development and commercialization of innovations – in the form of private-public-partnerships (PPPs). However, due to the *descripto-exploratory* nature of this study, the data collection, organization and data analysis was partly guided primarily by some grounded theory i.e. the researcher also took an inductive approach, whereby the "collection, examination and continual

re-examination of data determined the research findings" as propounded by Kalaian (2008) and Saunders *et al*. (2007: 115).

5.4 RESEARCH STRATEGY

Since the research paradigm was integrated based on the mixed-research design, the researcher used a mixed-method research strategy in order to realize the objectives of the study. Qualitative methods in the form of case studies were used so as to "create an in-depth and rich account" (Yin 2003; Zikmund, 2000) of how the research institutes commercialized their innovations and what the market thought or perceived of the institutes' products and their marketing efforts. Using this knowledge, the researcher simultaneously determined the factors facilitating and / or hindering the efforts of the research institutes through carrying out a survey. The survey strategy was utilized as part of the case study strategy, thus resulting in triangulation. Using the triangulation research strategy, the researcher simultaneously collected and analyzed both qualitative and quantitative facts, and used the results to validate findings from both studies, as posited by Kalaian (2008).

While the survey approach helped in addressing the *"who, what, where, how much and how many"* questions (Saunders *et al*., 2009), the case study approach addressed the *"why"* questions (Morris, 2003; Morris and Wood, 1991) of the research, hence both strategies were used to accomplish the descripto-exploratory design motives. The researcher used survey as a cost-effective strategy to collect bulky data from a relatively large population which consisted of both research institutes and technological innovation users. Using surveys also helped the researcher in collecting standardized data that facilitated easier comparison and explanation (data analysis), while enabling the researcher possess some degree of control over the research process. Since sampling was used, the use of survey further made it possible to generate findings that were deemed fairly "representative of the total population". Multiple cases were used and these were made up of different research institutes, both private and public, the rationale being based upon the need to establish *replicability* and generalizability of the findings on the different research institutes.

5.5 RESEARCH POPULATION

According to Cooper and Schindler (2008), population refers to the total mix of elements from which inferences are to be made. Target population refers to the group of research subjects or individuals possessing one or more common characteristics that are of interest and / or value to the researcher (Kwesu *et al*, 2002). In this study, target population identification was deemed a very necessary preliminary step, as it provided a base from which sample units and sample sizes were deduced. The

population of the study was made up of twenty (20) 'active' research institutes constituting both private and public research institutes. By 'active', it meant that the institute had to be fully operational with a capacity to produce marketable output (in the form of tangible, new products) and had to be registered with the Research Council, at least during the study period. Thus only those institutes meeting these criteria were part of the population. This ensured that the sample frame was constituted of only those research institutes with a capacity for commercialization.

The population was accordingly made up of 103 middle-to-top level staff members and 800 customers as determined by the institutes' databases.

5.6 SAMPLE AND SAMPLING

5.6.1 Research Sample

For the purposes of the study, all samples were drawn from the respective populations using Krejcie and Morgan's (1970) model, acknowledged and confirmed by The Research Advisors (2006), constructed from the formula:

$$\text{"}s = X\,2NP\,(1-P) \div d\,2\,(N-1) + X\,2P\,(1-P)\text{"}$$

Where:

s = required sample size,
$X2$ = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841),
N = the population size.
P = the population proportion (assumed to be .50 since this would provide the maximum sample size),
d = the degree of accuracy expressed as a proportion (.05) (Krejcie & Morgan, 1970:607).

Table 5.2 below shows an extract of the table for determining sample size from a given population (Krejcie and Morgan, 1970) courtesy of The Research Advisors (2006). Using this pre-determined samples table, the researcher acquired samples based on the respective populations available for the study. All samples were drawn at 95% confidence levels, at a 5.0% Margin of Error, which are the generally acceptable levels in research **(**The Research Advisors, 2006).

Table 5.2: An Extract Table for Determining Sample Size from a Given Population

Required Sample Size

Population Size	Confidence = 95% Margin of Error				Confidence = 99% Margin of Error			
	5.0%	3.5%	2.5%	1.0%	5.0%	3.5%	2.5%	1.0%
10	10	10	10	10	10	10	10	10
20	19	20	20	20	19	20	20	20
30	28	29	29	30	29	29	30	30
50	44	47	48	50	47	48	49	50
75	63	69	72	74	67	71	73	75
100	80	89	94	99	87	93	96	99
150	108	126	137	148	122	135	142	149
200	132	160	177	196	154	174	186	198
250	152	190	215	244	182	211	229	246
300	169	217	251	291	207	246	270	295
400	196	265	318	384	250	309	348	391
500	217	306	377	475	285	365	421	485
600	234	340	432	565	315	416	490	579
700	248	370	481	653	341	462	554	672
800	260	396	526	739	363	503	615	763

Source: ***The Research Advisors (2006:2)***

Of the twenty research institutes, 19 had been scheduled to be purposively sampled in view of Krejcie and Morgan's (1970) table for establishing sample size from a known or prescribed population, as shown above. However, a sample of 15 institutes was used due to the fact that the remaining institutes were not at liberty to allow their institutions to be used for research purposes, thus permission was not granted to include such in the study. These came mainly from the agricultural sector and they included some of SIRDC's research institutes (Biotechnology Research Institute, Environmental Sciences Institute, Building Technology Institute, Food and Biomedical Technology Institute, Geo-Info Remote Sensing Institute, Production Engineering Institute, Electronics and Communications Institute, Metallurgical Research Institute), Harare Institute of Technology, Cotton Research Institute, Coffee Research Station, Agronomy Research Institute, Pedstock Investments, Energy Technology Institute and Taisek Engineering. These represented about 65% of the research institutes in Zimbabwe, which was deemed a fair representation of the total sample thus rendering the results of this study generalizable and reliable.

Out the 800 "data-based" customers for the research institutes, a sample of 260 respondents was drawn using the same model (Krejcie & Morgan, 1970) and this represented 32.5% of the population. Regarding research institutes, interviews were held with six purposively sampled R & D and

commercialization and / or business development-related management staff, while a sample total of 94 respondents were drawn based of varying institutes' databases as follows:

Table 5.3: Staff Members' Sample Sizes per Research Institute

Institute	**Population *(N)***	**Sample *(n)***
SIRDC institutes (x 9 institutes)	65	56
Harare Institute of Technology	8	8
Cotton Research Institute	5	5
Coffee Research Station	10	10
Agronomy Research Institute	5	5
Pedstock Investments	6	6
Taisek Engineering	4	4
Totals	**103**	**94**

Source*: Developed by the Researcher*

As can be noted from Table 5.3 above, for populations of less than 50 cases or subjects, they were selected in their entirety as also supported by Henry (1990), who is apparently more of an opponent of probability sampling for such cases. Henry (1990) proposes that one must "collect data on the entire population as the influence of a single extreme case on subsequent statistical analyses is more pronounced than for larger samples" (quoted *in* Saunders *et al.,* 2007: 208).

5.6.1.1 Location and Geographical Dispersion of the Research Institutes

Figure 5.1: Geographical Dispersion of the Research Institutes Used For the Study

Source: ***Google Maps, 2013***

Although the majority of the research institutes were concentrated in Region 2 (Harare, the capital city), the nation was fairly represented in the sense that the study also engaged institutes from regions 3, 4, 5, 7 and 10. These institutes represented 65% of the research institutes in Zimbabwe, which was deemed a fair representation of the total sample, thus rendering the results of this study generalizable and reliable. The researcher engaged only those institutes where written consent was given, permitting use of their institutes for the purposes of this study. Most of the institutes preferred anonymity, especially regarding results presentation and analysis, and this was well observed by the researcher.

5.6.2 Sampling: Techniques and Procedures

Amongst many other methodology scholars, Trobia (2008) and Miller and Salkind (2002) point out two basic sampling methods, that is, "probability or representative sampling and non-probability or judgmental sampling". Due to the mixed nature of the study's methodology, the researcher used both probability and non-probability techniques. While the use of probability techniques allowed the researcher to statistically estimate the population characteristics from the sample, non-probability sampling techniques indeed made it possible to make some statistical inferences in to the characteristics of the population as guided by Saunders *et al.* (2009) and Trobia (2008).

The study utilized simple random sampling to select the sample of 260 customers out of a population of 800 respondents. Simple random sampling was also used in selecting a sample of 56 of 65 SIRDC's employees. With the increasing popularity and usage of various programs, the researcher used an Online Random Number Generator (Haahr, 2010), courtesy of *random.org* website. Simple random sampling was deemed necessary because the study subjects possessed almost similar characteristics and the geographical dispersion was somewhat concentrated (Saunders *et al.*, 2007). A number was assigned to each customer and / or employee from the relevant databases from 1 to 800 (for customers) and from 1 to 56 (for SIRDC institute's employees). Parameters were set in terms of the "minimum" and "maximum" numbers, followed by clicking the "generate" function repeatedly until the samples of predetermined size were drawn. Thus every subject of the population had an equal and independent chance of being incorporated or picked by the Random Number Generator. Using this online program ensured very limited researcher intervention thus reducing bias, at the same time ensuring that the desired samples could be selected with little effort (Miller & Salkind, 2002). Figure 5.1 below shows a snapshot view of the Random Number Generator taken from the *random.org* website.

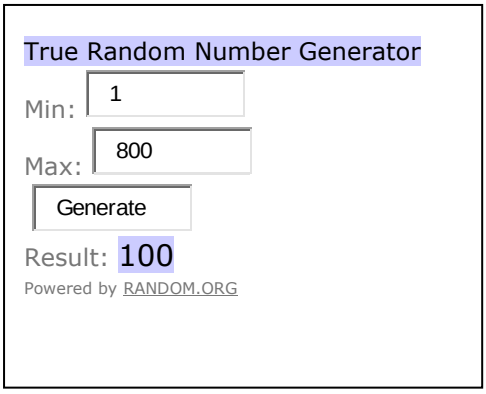

Figure 5.2: Online Random Number Generator Snapshot (Source: *random.org*, 2014; Haahr, 2010).

5.7 DATA COLLECTION INSTRUMENTS

Every research instrument has its own advantages and demerits, thus it is upon this *raison d'être* that methodology scholars such as Youngs and Piggot (2013) resoundingly call for and promote a mixture of both qualitative and quantitative research, and a mixture of different data collection techniques through triangulation.

In selecting the appropriate research instruments, the researcher was guided by Brewerton and Millward (2001) who advise researchers to consider that the research method or methods "be appropriate to your research objective; be able to produce a form of data appropriate to testing your hypothesis/hypotheses or addressing your research question(s);practicable given time, resource constraints and the feasibility of using it within a chosen or given context; and be ethically sound" (Brewerton & Millward, 2001:68).

Based on these guidelines, the researcher thus used the questionnaire and interviews as data collection instruments. These are outlined in the sections that follow.

5.7.1 Questionnaire

In the study, standardized self-administered questionnaires were designed and distributed to ninety four (94) research institutes' middle to top level staff members, who were randomly sampled from the institutes' Research and Development (R & D) and commercialization and / or Business Development departments. A standardized, self-administered questionnaire was also administered to 260 randomly selected customers.

A mixture of both open ended and closed ended questions were employed in order to solicit data that would help achieve the set research objectives. On the one hand, open ended questions left room for respondents to express their opinions, attitudes and perceptions of Zimbabwe's technological innovations and the commercialization status. On the other hand, closed ended questions guided respondents to give a definite answer. The use of both open ended and closed questions facilitated the use of both qualitative (open ended questions) and quantitative measurements (through closed questions).

When constructing an effective questionnaire the researcher, amongst other things, should choose questions and their form, wording and sequence in a manner that respondents can easily understand (Coldwell & Herbst, 2004). When they perceive or see the questionnaire as interesting, of value, short (Peterson, 2000), clearly thought through, and well presented (Burgess 2001), respondents are motivated to answer the questionnaire with little encouragement. Guided by these requirements, the researcher designed the questionnaire to be precise and interesting so as to solicit respondents' commitment to answer the questionnaire.

In order to reduce bias, the same questions were asked to every respondent within a given sample. Respondents were also given assurance regarding privacy and confidentiality of their individual responses. In most cases, the researcher or the trained research assistants had to wait for the respondents to complete the questionnaire in order to reduce failure to return the questionnaire, while at the same time encouraging respondents to answer all questions.

To assist in questionnaire administration, the researcher hired, trained and closely monitored data collectors who issued questionnaires to respondents. They waited for respondents to complete answering the questionnaire. Each data collector had a covering letter which, among other things, explained the purpose of the research. After reading through the cover letter and understanding the contents of the questionnaire package, the respondents were made to sign the consent form, which was collected together with the completed questionnaire.

5.7.1.1 Questionnaire Design

The questionnaires were designed following the 'funnel' approach to questionnaire development (Saunders *et al.*, 2007), in which the instrument commenced with more general level and / or broader questions before narrowing down to specific questions meant to address the study's specific research questions and objectives.

The first section **(Section A)** of the customer questionnaire consisted of the respondents' background information i.e. demographic data. This section was aimed at gaining information about the type of respondents in terms of their age groups, role in the family, economic well being etcetera, thus aiding in establishing the groupings that existed across and within the target population.

Section B required respondents to reflect on their access to the market as well as their preferences (if any) of the technological innovations from different research institutes.

Section C of the questionnaire sought to explore the respondents' attitudes and perceptions regarding Zimbabwe's technological innovations, thus the section provided respondents with an opportunity to react to the statements posed, indicating the extent to which they agreed or disagreed. This section utilized the five point Likert scales (Likert, 1932) which had the following measurements:
1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Neutral (N), 4 = Agree (A) and 5 = Strongly Agree (SA).

One last open ended question allowed respondents to state what they thought could be done to improve the general state of commercialization of new products in Zimbabwe.

The questionnaire for research institutes' staff members, which used the same structure as above, was intended mainly to gather the employees' views regarding the determinants of the commercialization of technological innovations in their respective institutes. (See Appendix 4 for the sample questionnaire for research institutes' staff).

5.7.2 Personal Interviews

In order to ascertain the existence, the determinant factors of, and the role played by Public-Private-Partnerships (PPPs), the researcher conducted six (6) semi-structured interviews with senior managers (Business development, sales and marketing and product commercialization related managers) conveniently selected from both private and public research institutes. For this particular qualitative element of the study, personal interviews were chosen as they proffered priceless and detailed information from knowledgeable managers. The five (5) respondents who eventually emerged offered abundant insights into the subject of PPPs in addressing the relevant research objective.
There are three approaches to gathering interview data and these include personal interviews, postal surveys and telephone surveys / interviews (Gillham, 2000). The researcher opted for personal interviews because they are completed through 'face-face contact' with the respondent(s) (Coldwell &

Herbst, 2004), thus the researcher found personal interviews to be most suitable because they reaped the following advantages:

a) Interviews provided invaluable responses within the participants' or research institutes' contexts.

b) The use of "pre-determined questions", based on the interview guide, helped in ensuring some degree of response uniformity.

c) Compared to questionnaires, they yielded higher return because of spot answering.

d) The information was first hand with less distortion.

e) The dialogue led to the provision of verified facts to a larger extent, presenting the researcher (interviewer) with an opportunity to probe for more information.

f) Language could be modified in the process thus assuring at least some response to all questions posed.

h) The researcher had the opportunity to observe gestures i.e. non-verbal cues.

A template of the Interview Guide used (for personal interviews) is found is **Appendix 5** of this write-up.

5.7.2.1 Interviews Sample Size's Saturation

The 'guiding principle' in determining the sample size in carrying out studies with a component of qualitative research has remained the theory of saturation (Mason, 2010). Though the concept has been explored in detail by numerous authors, the question remains, "How many interviews are enough?" (Mason, 2010; Guest *at al.*, 2006). In addressing this dilemma, the current study was guided by Charmaz (2006: 114) who clearly states that:

> *" The aims of the study are the ultimate driver of the project design, and therefore the sample size…small study with 'modest claims' might achieve saturation quicker than a study that is aiming to describe a process that spans disciplines (for example describing drug addiction in a specific group rather than a description of general addiction)…"*

Thus, guided by this and other related contributory principles, five (5) interviews conducted were deemed sufficient, given that the study's methodology was mixed and interviews were primarily meant to achieve the third objective of the study, which read, "To explore the role of Private-Public Partnerships (PPP's) in ensuring successful Research and Development, and Commercialization (R & D-C) of research outcomes."

5.7.3 Secondary Data Review

Secondary data involved a systematic review of appropriate information from journal articles, textbooks, e-books, databases, policy documents and other relevant sources. Secondary data was helpful as it gave the researcher the necessary background and guidelines to the research. Past empirical studies on commercialization of innovations were reviewed thus providing the researcher with insights on past results on studies related to the current study. This gave room for comparison, critical thinking and analysis of result trends which assisted in drawing conclusions for the study.

5.8 PILOT TEST

A pilot test was carried out on twelve (12) randomly selected respondents to check and establish any possible flaws in its design. The respondents understood what was expected of them in responding to the questionnaire. However, two respondents felt that question 7 in section A of the customers' questionnaire, which enquires about respondents' role in the family buying unit, was not clear. After explaining what the question meant and rephrasing it, the respondents understood the question and its relevance to the study.

The pilot study was also meant to explore, among other things, the adequacy of the research design (Schostak, 2006), the appropriateness of the questionnaire's length, standard time needed to complete the questionnaire, and whether target respondents were comfortable to answer all questions. All minor issues raised were attended to in ensuring consistency in all data collection instruments. Expert opinions were also sought from senior academics in innovation management area before finalizing the data collection instruments. All adjustments to the data collection instruments were made in cognizance of the study's objectives.

5.9 DATA COLLECTION PROCEDURE AND RESPONSE RATE

5.9.1 Data Collection Procedure

The following procedure was used by the researcher:

1. Official consent and approval was sought from the research institutes that were included in this study hence Ethical Clearance, ***HSS/0457/013D*** was obtained from UKZN through the Humanities and Social Sciences Research Ethics Committee (see Appendix 1 for the Ethical Clearance Certificate).
2. Questionnaires were personally distributed to the respondents by the researcher, with the assistance of two trained data collectors over a period of one week. Each respondent was

given at least one day to complete the questionnaire. The researcher and his assistants were always at hand to assist respondents who needed any help in completing the instruments. Consent was sought before respondents could fill in the questionnaire. To avoid disruption of company activity, especially in the case of research institutes' staff, questionnaires were collected on agreed dates.

3. Regarding interviews, participants were interviewed in person after making appointments by telephone. An interview guide was produced and a copy was provided to interviewees so as to encourage them to volunteer exceptional and invaluable information as propounded by Yin (1994; 2003). Interviewees were presented with broad, open ended research questions and responses were recorded in writing. Follow-up questions were asked based on the extant literature surrounding the subject of PPPs. All interviews were conducted between March and May 2014. The responses to the open interviews were coded, counted, cross-case analyzed (Patton, 1990) and thematically grouped, i.e. clustered into themes. Since the interviews were aimed at addressing one specific objective, outlier responses were set aside for any other research need that could arise in future. Part of Chapter 6 summarizes findings from interviewees in addressing the research objective.

5.9.2 Response Rate

A total of 260 questionnaires were distributed to customers while 94 questionnaires were distributed to research institutes' staff. A total of six interviews were also arranged for the study. The use of trained research assistants and consistent follow-ups yielded 341 useable responses (251 from customers and 90 from research institutes' staff), while five of the intended six interviews were conducted. This gave an aggregate response rate of 95.83%. Details response and response rates are accounted for in Table 5.4 below.

Table 5.4: Overall Response Rate

Respondent Category	Total Sample	Return	Return %age	Overall Response %age
Customers	260	251	96.53	95.83
Institutes' Staff	94	90	95.74	
Management (Interviews)	6	5	83.33	
Total	**360**	**345**		

Cases of missing data were evaluated, non-response cases were verified and such variables were eliminated during the data cleaning process.

5.10 RESEARCH FINDINGS VALIDITY AND RELIABILITY

Diverse scholarly views have resulted in numerous methods for assessing validity, each method appraising or assessing rather different aspects (Keller, 2006). Though not the sole method used in the study, triangulation has been commonly associated with the enhancement of research findings validity (Youngs & Piggot, 2013).

The researcher conducted Cronbach's Alpha (α) reliability test (Cronbach, 1951) as part of determining the reliability of the study's results. The value of α varies between 0 and 1; the closer it is to 1, the stronger the internal cohesion of the scale (that is, its reliability). Values of at least 0.7 are said to be generally acceptable (Drucker-Godard *et al.*, 2001). Cronbach's Alpha internal testing was also conducted to establish internal consistency of the instruments in addressing the research objectives. The results of the tests showed that there was a very high level of internal reliability and consistency (0.9288) especially among the items that employed the Likert scale. In order to determine this value, Likert scale items were grouped into themes and each theme's set of questions was tested for reliability separately. Thus Cronbach Alpha tests were run on questions addressing commercialization determinants (Theme 1) and customer perceptions (Theme 2) as these emerged to be the main themes of the study. Separate tests were run for the two questionnaires used. Tables 5.5 and 5.6 below summarize the results.

Table 5.5*a*: Cronbach's Alpha (α) Test Results for Theme 1 (Staff Questionnaire)

Dimension	Cronbach's Alpha	Variance Accounted For
		Total (Eigenvalue)
1	.883	5.910
2	.789	3.884
Total	.954[a]	9.794

The total Cronbach's Alpha (0.954) is measuring the internal consistency of the following variables: Local Preference, Public Awareness, Location Awareness, Accessibility, Resource Commitment, Education, Training, Test Marketing, Technology, Patent Protection, Information Dissemination, Government Support, R & D Staff Motivation, Marketing Staff Motivation, Use of Feedback, Economic Support, and Sectoral Support which were designed to measure the commercialization determinant factors in the questionnaire for Research Institutes). These questions (variables) were divided into two themes with the respective values for the Cronbach's Alpha.

Table 5.5*b*: Cronbach's Alpha (α) Test Results for Theme 2 (Staff Questionnaire)

Dimension	Cronbach's Alpha	Variance Accounted For	
		Total (Eigenvalue)	% of Variance
1	.655	2.475	22.496
2	.631	2.347	21.338
Total	.872[a]	4.822	43.833

The total Cronbach's Alpha (0.872) is measuring the internal consistency of the following variables: Demand-Pull, Technical Excellence, Time Lags, Follow Ups, Technological Infrastructure, Biased Funding, Resource Unavailability, Remuneration, Management Flows, Costs, and Patent Laws which were designed to measure the respondent perception variables in the questionnaire for Research Institutes. These questions (variables) were also divided into two themes with the respective values for the Cronbach's Alpha.

The average Total Cronbach's Alpha for Research Institutes is 0.913. This is the overall Cronbach's Alpha for the questionnaire on Research Institutes' Likert scaled questionnaires, as measured by the internal consistency of 0.954 and 0.872 obtained in Tables 5.5*a* and 5.5*b* above.

Table 5.6*a*: Cronbach's Alpha (α) Test Results for Theme 1 (Customer Questionnaire)

Dimension	Cronbach's Alpha	Variance Accounted For	
		Total (Eigenvalue)	% of Variance
Theme 1	.908	6.369	45.493
Theme 2	.723	3.040	21.711
Total	.962[a]	9.409	67.204

The total Cronbach's Alpha (0.962) is measuring the internal consistency of the following variables: Prefers Local to Imports, High Quality Innovations, Innovations are Unique, Innovations are Original, Innovations are Affordable, Research Institutes give Support to Innovations, Innovations are Market-driven, Technology-driven Innovations, Easily Accessible in the Market, Innovations are Safe, Innovations are User Friendly, Well Promoted/ Communicated, Knows where to Buy and/ or Check for New Products, and Meet Respondent's Expectations which were designed to measure the customers' perceptions of technological innovations in Zimbabwe. These questions (variables) were divided into two themes with the respective values for the Cronbach's Alpha.

Table 5.6*b*: Cronbach's Alpha (α) Test Results for Theme 2 (Customer Questionnaire)

Dimension	Cronbach's Alpha	Variance Accounted For	
		Total (Eigenvalue)	% of Variance
1	.861	4.451	44.509
2	.411	1.586	15.864
Total	.927[a]	6.037	60.372

The total Cronbach's Alpha (0.927) is measuring the internal consistency of the following variables: Low Price, Purchasing a 100% Zimbabwean Brand, Purchasing an Import, Product Quality, Market Education/ Communication, Brand Originality, User Friendliness, Country of Origin, Product Uniqueness, and Market Access, which were designed to measure the customers' views on commercialization determinant factors in the questionnaire for customers. These questions (variables) were divided into two THEMES with the respective values for the Cronbach's Alpha.

Average Total Cronbach's Alpha for Customers is 0.9445. This is the overall Cronbach's Alpha for the questionnaire on customers, as measured by the internal consistency of perceptions, i.e. 0.962 and determinant variables, i.e. 0.927.

A consideration of the results from both research institutes and consumers' emerging themes gives an average Cronbach's Alpha of 0.9288, thus the data collected was deemed very reliable.

5.11 ETHICAL CONSIDERATIONS

Data collection ability relies on whether access to the data source(s) has been obtained. To this end, Saunders *et al.* (2009) laments, "gaining physical access may be difficult because individuals may not be interested or prepared to participate in voluntary activities due to time constraints". Organizations and individual participants who usually form the study's subjects normally find it "difficult to cooperate if they do not see value of the study or if they have doubts about the credibility and competence of the researcher and more so if they are not certain the information they provide will be treated with confidentiality" (Bell, 2008:88). Because the current study involved human subjects, the following ethical considerations were taken aboard:

- Research permission was sought, and obtained; from the research institutes involved and the study encompassed only those institutes whose permission was granted.
- Following written permission from the research institutes as evidenced by the signed Gatekeepers consent forms, Ethical Clearance (EC) was sought and obtained (E.C. Number ***HSS/0457/013D***) from UKZN, through the Humanities and Social Sciences Research Ethics Committee (see **Appendix 1** for the Ethical Clearance Certificate).
- Respondents' consent was sought, through signing the consent form (Appendix 2), before the respondents could complete any questionnaire or answer any interview question. Signing the consent form meant that the respondent would have read and understood the contents of the data collection instruments as well as the nature of the study. It was made plain to them that they could freely withdraw from their study at any time.
- Respondents' privacy, confidentiality and anonymity were assured regarding the respondents' identity and responses, and this was honoured.

5.12 QUANTITATIVE AND QUALITATIVE DATA ANALYSIS

Data for the study was primarily acquired through two pre-coded self-administered questionnaires, personal interviews, and secondary data sources. The Statistical Package for Social Sciences (SPSS) version 22.0 was utilized to statistically analyze the data gathered. Both descriptive and inferential statistical analyses were conducted. Perceptual mapping was also done to display the perceptions of consumers towards local technological innovations where the positioning of such was reflected relative to their competing imports. The researcher also made use of IBM SPSS *Text Analytics* to sort, code and analyze the qualitative data collected from face-to-face interviews as well as for qualitative data that emerged from the questionnaires. The qualitative data were sorted into themes and relevant subsets of the data were located according to the specific themes. Figure 5.3 illustrated below, was used by the researcher as a steer for data analysis.

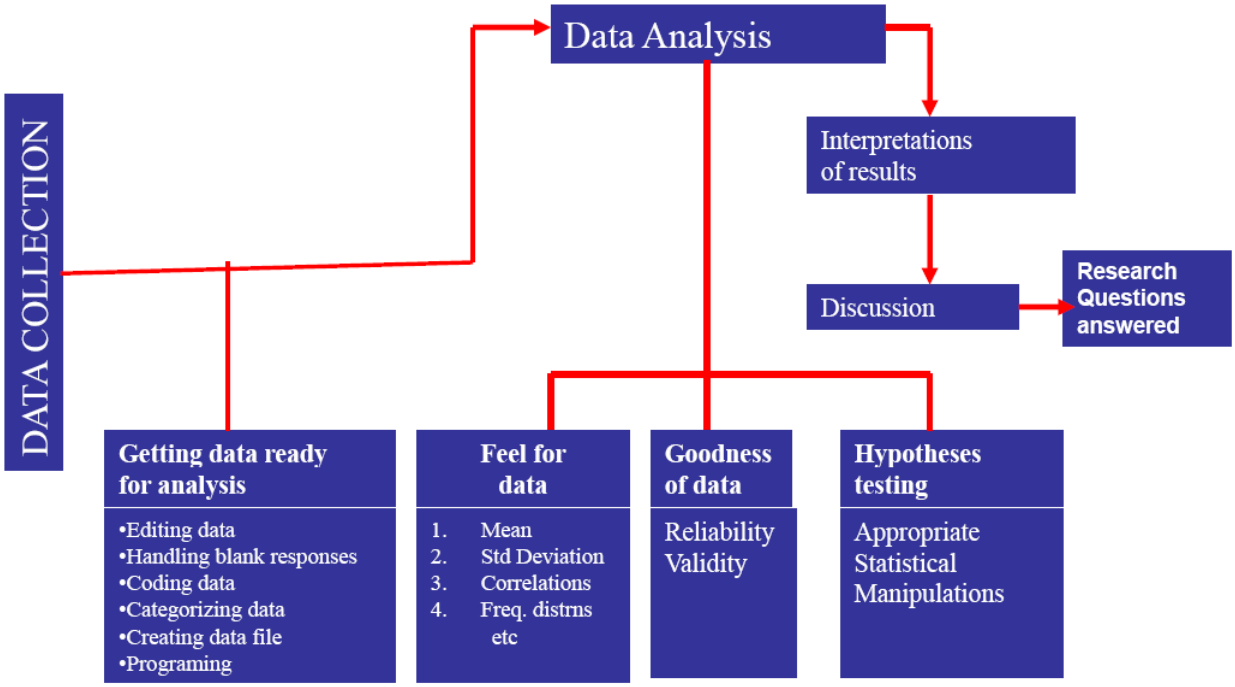

Figure 5.3: Flow Diagram of Data Analysis Process (Source: Sekaran, 2003)

As the study also attempted to measure the respondents' attitudes and perceptions of Zimbabwe's technological innovations, the data analyzed from this survey was clearly non-parametric in nature and non-parametric statistical techniques were thus employed in addressing this particular objective, as suggested by Everitt and Wykes (1999).

5.13 CHAPTER SUMMARY

This methodology chapter has given an explicit account of how the study was carried out in terms of the adopted research design and paradigm, the research strategy, sampling techniques, data collection instruments and how the critical research issues of data validity and reliability were ensured. The chapter also tackled how research ethics were considered and summarized how data analysis for the study was conducted. In summary, the study utilized mixed research methodology based on the integrative nature of the research design and philosophy. The next chapter presents and analyzes the study's findings.

CHAPTER 6

DATA ANALYSIS AND PRESENTATION OF RESULTS

6.1 INTRODUCTION

The study sought to establish the determinants of commercialization of technological innovations in Zimbabwe's research institutes. It sought to establish why Zimbabwe's innovations are failing to 'sail into the market', how customers perceive Zimbabwe's local innovations vis-à-vis their innovation expectations as well as the role played by Private-Public-Partnerships (PPPs) in the commercialization of technological innovations in Zimbabwe. Based on the study's conceptual framework, several hypotheses were proposed and tested. A model was formulated and proposed to resolve the research problem at hand.

This chapter presents the respondents profiles together with sample characteristics, and tests the study's proposed model using Structural Equation Modelling (SEM). More specifically, this chapter reviews and discusses the fit indices in structural equation modelling using AMOS, discusses the development of the constructs' measurements, assesses and analyses the overall measurement model fit, reports and assesses the various correlations of the study's main variables, examines and validates the relevant constructs and tests the proposed original models in a bid to establish the final theoretically credible model. Guided by Coolican (2009, 1990), the significance of the test results mainly ranged from the 0.01 level of significance to the 0.05 level of significance. In some cases, the 0.001 level of significance was also used. All probabilities reported were based on two-tailed tests. This was due to the fact that the comparisons had two possible directions.

This chapter presents both descriptive and inferential statistics for the study's results. The chapter does not draw any implications of the results nor does it discuss the findings as these are presented later in Chapter 7. The study hypothesized that the identification of determinants which could lead to successful commercialization of technological innovations in developing countries could lead to the creation of sustainable economies in most third world African countries such as Zimbabwe. The study's objectives were four-fold: to establish the determinants of "successful commercialization" of technological innovations in Zimbabwe's research institutes; to determine customer perceptions on the state of innovations commercialization in Zimbabwe vis-à-vis their innovation expectations; to establish the role of Private-Public Partnerships (PPPs) in the commercialization of technological innovations; as well as to develop a roadmap as an intervention tool in policy-making as a way forward based on the research findings.

6.2 RESPONDENTS' DEMOGRAPHICS

In terms of sample demographics, the respondent characteristics varied widely. This section presents the relevant personal data of the respondents including their gender, age groups, job positions, educational qualifications and economic well-being, among other factors.

6.2.1 The Descriptives for Customers

Table 6.1: Customer Respondents' Profile

Demographic Variable	Frequency	Percentage
Gender		
Male	143	57.0
Female	108	43.0
Total	251	100.0
Age group of Respondents		
16 - 24 years	40	15.9
25 - 34 years	56	22.3
35 - 44 years	66	26.3
45 - 54 years	59	23.5
55 years or older	30	12.0
Total	251	100
Mean = 38.90, s.d. = 6.253		
Highest Level of Education		
Junior certificate	12	4.8
Secondary school certificate	10	4.0
High school certificate	25	10.0
Post-secondary diploma(s)	65	25.9
Bachelors degree(s)	112	44.6
Post-graduate degree(s)	27	10.8
Total	251	100.0
Area of Residence		
Urban	109	43.4
Rural	48	19.1
Peri-urban	94	37.5
Total	251	100.0
Economic well-being		
Poor	4	1.6
Below average	16	6.4
Average	169	67.3
Above average	56	22.3
Flourishing	6	2.4
Total	251	100.0
Household Size		
"I stay alone"	5	2.0
2 members	14	5.6
3 members	19	7.6
4 members	35	13.9
5 members	92	36.7
More than 5 members	86	34.3
Total	251	100.0
Mean = 4.80, s.d. = 1.2545		
Respondent's role in the family		
Initiator	38	15.1
Buyer	76	30.3
Decision-maker / Decider	60	23.9
Influencer	73	29.1
Gatekeeper	4	1.6
Total	251	100.0

Table 6.1 shows that male representation dominates with 57% while female respondents trail behind with 43%. The table also shows that the distribution of the age follows a normal distribution with the 35–44 age group being the dominant one (26.3%), followed by the relatively old generation of 45–54 years (23.5%) and the younger generation (25–34; 16–24) following closely at 22.3% and 15.9% respectively. The economic well-being of the respondents is modally average. The majority of the respondents have post-secondary diplomas and bachelor's degrees (70.5%). The table reveals that respondents are varied in terms of their ages. The preferred areas of residence seem to be the urban (43.4%) and peri-urban areas (37.5%), with the remainder (19.1%) indicating that they reside in the rural areas.

As reported in Table 6.1, an average size of the respondents' households is made up of 5 members while households of more than 5 members commanded 34.3%. The respondents' roles in the family are modally "buyers" (30.3%), followed closely by "influencers" with a frequency of 29.1%.

6.2.2 The Descriptives for Research Institutes' Respondents

Table 6.2 shows that male representation also dominates within research institutes' staff respondents with 61%, while female respondents constitute 38.9% of the respondents. The technical department has the highest number of hits (38) making up 42.2% of the total research institutions surveyed. Sales and marketing, together with the Business Development Units account for 36.6% of the institutes' departments. The Production and Public Relations departments each have 10 respondents constituting 11.1% of the departments surveyed at research institutes.

Table 6.2: Research Institutes' Respondents' Profile

Demographic Factor	Frequency	Percentage
Gender		
Male	55	61.1
Female	35	38.9
Total	90	100.0
Respondents' Department		
Sales and Marketing	14	15.6
Production	10	11.1
Business Development	18	20.0
Technical	38	42.2
Public Relations	10	11.1
Total	90	100.0
Length with Research Institute		
Less than 1 year	15	16.7
2 to 5 years	23	25.6
6 to 10 years	32	35.6
11 to 15 years	10	11.1
More than 15 years	10	11.1
Total	90	100.0
Mean = 8.74, s.d. 1.1951		

Table 6.2 also reports that the average length or experience of the respondents within their respective institutes is 8.74 years. Most of the respondents in this sample (57.8%) have more than five years of experience with their institutes, which may indicate that the respondents are quite experienced in their various areas of specialization.

Attributes related to the research institutes were considered an essential part of the study's analysis to classify participating institutes[4].

Table 6.3: Research Institutes' Attributes Profile

Attribute	Public		Private		Total	
	Frequency	%age	Frequency	%age	Frequency	Overall %age
Research Institutes' Sector of Respondents	48	53.3	42	46.7	90	100.0
Availability Of Commercialization Units / Depts.						
Yes	17	35.4	33	78.6	50	55.6
No	31	64.6	9	21.4	40	44.4
Total	48	100.0	42	100.0	90	100.0
New Product Introduction within the last 12 - 24 months						
Yes	20	41.66	31	73.8	51	56.7
No	28	58.34	11	26.2	39	43.3
Total	48	100.0	42	100.0	90	100.0
Categories of TIs Commercialized						
Electronic gadgets	2	5.56	4	8.33	6	7.14
Agricultural inputs	10	27.78	21	43.75	31	36.90
Food items and herbs	11	30.56	9	18.75	20	23.81
Farming Implements	4	11.11	7	14.58	11	13.10
Building Materials	2	5.56	4	8.33	6	7.14
Auto parts and accessories	7	19.44	3	6.25	10	11.90
Total	36	100.0	48	100.0	84	100.0
Researcher Attitude towards innovation						
Willing	22	45.8	12	28.6	34	37.8
Reluctant	7	14.6	8	19.0	15	16.7
Demotivated	8	16.7	13	31.0	21	23.3
Not sure	11	22.9	9	21.4	20	22.2
Total	48	100.0	42	100.0	90	100.0
Commercialization State						
Excellent	4	8.3	0	0	4	4.4
Good	7	14.6	1	2.4	8	8.9
Above average	5	10.4	11	26.2	16	17.8
Average	13	27.1	11	26.2	24	26.7
Poor	19	39.6	19	45.2	38	42.2
Total	48	100.0	42	100	90	100.0

Table 6.3 reveals that 53% of the responses derive from public research institutes staff while 46.7% of the responses come from private research institutes. Commercialization Units or departments do exist in 50 (55.6%) of the research institutes, with the majority (66%) of these units being found in the private sector, compared to 17 (34%) in public research institutes.

[4]In the interests of confidentiality and in compliance with the requirements of the University of KwaZulu-Natal Research Ethics guidelines, the names of research institutes, respondents, and locations have been withheld and are replaced with an anonymous unique identifier [in brackets] when mentioned in direct quotes, especially in the qualitative results section.

The table also clarifies that 56.7% of the research institutes have introduced a new product within the past 12 to 24 months, the majority of such firms being private research institutes, constituting 61%. However, 43.3 % have not introduced a new product, 72% of these being public institutes.

Agricultural inputs top the list of the new products commercialized, with 36, 90% while electronic gadgets and building materials represent the least commercialized group of TIs with 7.14% each. In terms of researcher attitude towards innovation, the majority in the public sector (45.8%) is generally willing while the majority within the private sector (31.0%) is rather demotivated, though 28.6% indicate that they are willing. On average, the majority (37.8%) across all sectors indicate willing researcher attitudes towards innovation. It is apparent from Table 6.3 that the aggregate majority (42.2%) describe the commercialization state of Zimbabwe's technological innovations as generally poor. Only 4 (4.4%) describe the state of commercialization as excellent while 26.7% describe the state as average, i.e. neither poor nor good.

Table 6.3 also reveals that even though the majority of the respondents (56.7%) indicate that their institutes introduced some new products to the market, there remains 43.3% whose institutes have not introduced any new product within the past 12 to 24 months. The majority of such institutes (72%) are the public research institutes.

In order to establish how the respondents perceived the rate of New Product Development (NPD) in their respective institutes, respondents were asked how they rated the NPD state. Table 6.4 shows the results.

Table 6.4: Views on rate of NPD

Response	Frequency	Percent	Valid Percent	Cumulative Percent
Poor	21	23.3	23.3	23.3
Average	33	36.7	36.7	60.0
Above average	19	21.1	21.1	81.1
Good	17	18.9	18.9	100.0
Total	**90**	**100.0**	**100.0**	

The majority (36.7%) of the respondents affirm that the NPD rate is average, followed by 23.3% who rate the NPD rate as poor. This is followed closely by 21.1% who feel that the rate is above average while 18.9% rate NPD as good.

6.3 FAILURE BY RESEARCH INSTITUTES TO COMMERCIALIZE

The reasons for not having introduced new products by varying research institutes were extracted and ranked from the most important to the least important. Table 6.5 below summarizes the rankings, as extracted from the data.

Table 6.5: Ranking of the Reasons for Failure to Commercialize Innovations by Institutes

		Reason	Responses (%age)		
			Aggregate	Others	Total
1.	**Most Important Frequencies**	Financial Constraints	63.9	36.1	100
2.	**Second most frequencies**	Lack of Proper Infrastructure	44.4	55.6	100
3.	**Third most frequencies**	Long time lag between Research & Commercialization	30.6	69.4	100
4.	**Fourth most frequencies**	Lack of Researchers' Commercialization Interest	44.4	55.6	100
5.	**Fifth most frequencies**	Lack of Mass Market Production Capacity	50.0	50.0	100
6.	**Least frequencies**	Patents	69.4	30.6	100

For the ranking of reasons for not managing to commercialize new technological breakthroughs, financial constraints are ranked as the most important by 23 of the respondents, constituting 63.9% of the most important reason rankings. Lack of proper infrastructure is the second most ranked while patents are affirmed as the least important by 25 respondents, constituting 69.4% of the least important rankings.

6.4 NEW PRODUCT ACCESS BY CUSTOMERS

Of the commercialized innovations, respondents were asked if they had purchased and / or used any new product from any institute in the past 12 to 24 months. Figure 6.1 below shows the outcome.

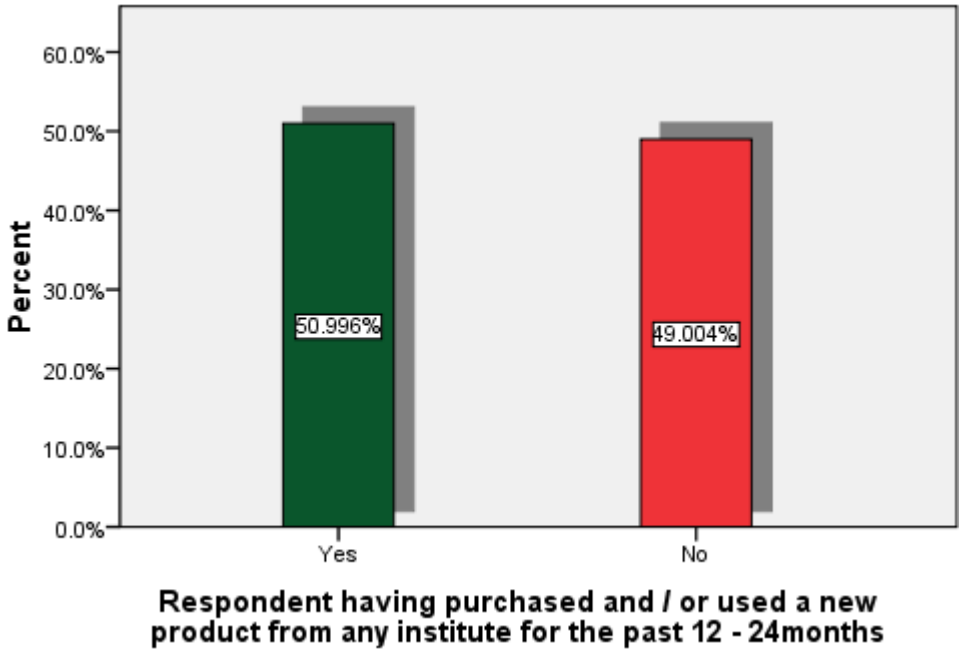

Figure 6.1: Respondents Access to New Products

The results show a very thin line between those who indicate that they have managed to purchase and / or use a new product and those who indicate that they did not. While 50.99% indicate that they have accessed new products, almost the other half (49%) of the responding customers report not purchasing and / or using at least one new product from any research institute during the previous 12 to 24 months. The reasons for not having purchased and / or used at least one new product were ranked from most important to least important.

Table 6.6: Ranking Of the Reasons for Not Having Purchased And / Or Used New Products from Any Institute in the Past 12-24 Months

		Reason	Responses (%age)		
			Aggregate	Others	Total
1.	**Most Important Frequencies**	Lack of access / market unavailability	51.6	48.4	100
2.	**Second most frequencies**	Lack of awareness as reason	54.9	45.1	100
3.	**Third most frequencies**	High price	50.4	49.6	100
4.	**Fourth most frequencies**	Lack of product uniqueness	52.0	48.0	100
5.	**Fifth most frequencies**	Poor safety and user-unfriendliness	68.3	31.7	100
6.	**Least frequencies**	Import preference	77.2	22.8	100

For the purposes of ranking reasons for not purchasing and / or using at least one new product, "lack of access or market unavailability" is ranked as the most important by 64 of the responding customers,

constituting 51.6% of the most important rankings. Import preference is overwhelmingly labeled the least important reason for not purchasing or using local innovations by 95 of the responding customers, constituting 77.2% of the least important rankings.

6.5 DETERMINANTS OF COMMERCIALIZATION

Table 6.3 indicates that 56.7% of the research institutes under study managed to introduce a new product within the past twelve to twenty-four months. This section establishes the types of new products introduced as well the commercialization determinants of such innovations. In an effort to determine the nature of new products introduced by the various institutes, respondents were asked to indicate the categories into which their respective institutes' new products fell. Table 6.7 summarizes the findings.

Table 6.7: New Products Commercialized

	New Product Category	Frequency	Percent	Valid Percent	Cumulative %
Valid	Electronic gadgets	6	6.7	11.1	11.1
	Agricultural inputs	30	33.3	55.6	66.7
	Food items and herbs	11	12.2	20.4	87.0
	Farming implements	1	1.1	1.9	88.9
	Building materials	1	1.1	1.9	90.7
	Auto parts and accessories	5	5.6	9.3	100.0
	Total	54	60.0	100.0	
Missing	System	36	40.0		
Total		90	100.0		

As shown in Table 6.7 above, agricultural inputs top the new products commercialized with a frequency of 30 (33.3%), followed by food items and electronic gadgets, with 20.4% and 11.1% respectively. Farming implements and building implements are lowest on this list with a frequency of only 1.1% each. Given that the questionnaire had a conditional question (Question 8 – see Sample Research Institutes' Questionnaire in Appendix 4), it was expected that those respondents who indicated that their research institutes had not commercialized any technological innovation within the past 12-24 months would not respond to this particular question, hence missing responses were anticipated. The firms were consequently asked what drives them to develop and eventually commercialize new products. The drivers are presented in Table 6.8 below.

Table 6.8: Drivers of New Product Development (NPD) and Commercialization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Changes in technology	26	28.9	48.1	48.1
	Availability of R & D Staff	9	10.0	16.7	64.8
	Our mandate	10	11.1	18.5	83.3
	Market trends	9	10.0	16.7	100.0
	Total	54	60.0	100.0	
Missing	System	36	40.0		
Total		**90**	**100.0**		

Table 6.8 shows that the major drivers of NPD and commercialization in Zimbabwe are changes in technology (48.1%), followed by the research institute's mandate (18.5%), while market trends and availability of R & D staff trail behind.

The questionnaire further sought to establish the methods used by the various research institutes in creating market awareness for their new customers. Table 6.9 below shows that creation of market awareness is mainly done through newspaper advertisements (32.1% - valid percent), followed by the use of customer walk-ins (38.3% - valid percent). Internet and internal marketing are not usually used, as reflected by a frequency of 5.7% (valid percent) each. Respondents were probed to indicate any other methods used, hence the creation of market awareness through magazines emerged.

Table 6.9: Research Institutes Methods of Market Awareness

		Frequency	Percent	Valid Percent	Cumulative %
Valid	Newspaper advertisements	17	18.9	32.1	32.1
	Through internal marketing	3	3.3	5.7	37.7
	Internet	3	3.3	5.7	43.4
	Through customer walk-ins	15	16.7	28.3	71.7
	Product launch campaigns & exhibitions	14	15.6	26.4	98.1
	Other	1	1.1	1.9	100.0
	Total	53	58.9	100.0	
Missing	System	37	41.1		
Total		90	100.0		

6.5.1 Factors Hindering the Commercialization of Technological Innovations

The study intended to determine the hindering factors of commercialization of technological innovations in Zimbabwe. In order to establish these, institutional staff respondents were asked the extent to which they felt certain factors (as guided by literature) would hinder their respective research

institutes' efforts in commercializing technological breakthroughs. The table below is a composition of how each factor was separately rated by respondents.

Table 6.10: The Extent to Which Different Factors Hinder New Product Commercialization

Factor	Frequencies						
	Not at all		*To some extent*		*To a large extent*		*Weighted Extent*
	N	%	N	%	N	%	%
Demand Pull	9	8.00%	13	5.60%	30	13.30%	9.37
Technical Excellence	12	10.60%	19	8.20%	21	9.30%	8.71
Time Lags	5	4.40%	17	7.30%	30	13.30%	10.24
Follow Ups	8	7.10%	32	13.70%	12	5.30%	9.59
Infrastructure	7	6.20%	10	4.30%	35	15.50%	9.80
Biased Funding	7	6.20%	30	12.90%	15	6.60%	9.80
Resource Unavailability	10	8.80%	22	9.40%	20	8.80%	9.15
Remuneration	12	10.60%	28	12.00%	12	5.30%	8.71
Management Flows	13	11.50%	25	10.70%	14	6.20%	8.50
Costs	2	1.80%	25	10.70%	25	11.10%	10.89
Patent Laws	28	24.80%	12	5.20%	12	5.30%	5.23
Totals	113	100.0%	233	100.0%	226	100.00%	100

In the above table, a total of 226 responses are recorded as indicating one of the reasons that could hinder commercialization of Technological Innovations (TIs) *to a large extent*. Of these responses, lack of infrastructure is a factor most likely (with 15.5%), to hinder the commercialization of TIs, followed by longtime-lags between NPD and commercialization (13.3%) and costs (11.1%). Lack of follow ups, low staff remuneration, and patent laws have the lowest frequency of 12 responses, constituting 5.3% each.

In the same table, 233 responses are recorded as having indicating one of the reasons that could hinder commercialization of TIs *to some extent*. Of these responses, lack of follow-ups (13.7%) is a factor most likely to hinder the commercialization of TIs *to some extent*, followed by biased commercialization funding (12.9%) and poor remuneration (12%). Patent laws are shown as the least likely hindering factor in this category, constituting 5.2% of the respondents.

A total of 113 responses are recorded as indicating one of the reasons as a factor that could not at all hinder the commercialization of TIs. At the top of the list is patent laws with 28 (24.8%) of the responses. This was predictable from the above two tables where it was never considered to be of any significant extent. It would appear to suggest that Costs is a factor that should not be left out when

considering the factors that can hinder commercialization of the TIs. This inference is based on the 2 responses which make up 1.8% of the total responses in the *not at all* category.

Based on weighted averages of the extent to which each barrier would affect commercialization, the table shows that commercialization costs dominate with 10.89%, followed by increased time lags between NPD and commercialization (10.24%). Poor infrastructure and biased funding follow with 9.80% each. The weighted extent further confirms that Patent Laws are least likely to affect commercialization (5.23%).

"Other hindrances" to the commercialization emerging from the questionnaire include inconsistent political-economic environment, inadequate funding, poor cooperation and poor quality of products.

6.5.2 Customers' Views on Commercialization Determinants

In further pursuing the objective of establishing commercialization determinants, research institutes' customers were asked to rate the value they would place, from *totally unimportant* to *very important*, on different variables when purchasing new products. The following ratings where summarized.

Table 6.11: Ratings on Value placed by Customers on different attributes when purchasing new products

Attribute	Value Frequency (%)				
	Totally unimportant	Unimportant	Important	Very important	Total
Low price	6.2	51.6	20.3	21.9	100
Purchasing a 100% Zimbabwean brand	18.8	14.1	18.0	49.2	100
Purchasing an import	39.1	26.6	17.2	17.2	100
Product Quality	0	0.8	48.4	50.8	100
Market education / Communication	0	5.5	24.2	70.3	100
Brand Originality	6.2	8.6	19.5	65.6	100
User friendliness	0	3.9	57.8	38.3	100
Country of Origin	6.2	14.1	18.8	60.9	100
Product uniqueness	4.7	2.3	13.3	79.7	100
Market access	0.8	3.1	13.3	82.8	100

From the table above, it emerges that the bulk (57.8%) of the respondents do not place any importance on the new product's price, while the rest of the attributes are ranked from important to very important when making a new product purchase. Market access (82.8%), product uniqueness (79.7%)

and market education (70.3%) claim the top three rankings in terms of importance, mostly labeled as "very important".

Table 6.12: Summary Statistics on Value placed by Customers on different attributes when purchasing new products

Attribute	N	Min	Max	Mean	S.D.
Value placed by the respondent on "low price" when purchasing new products	128	1	4	2.58	.902
Value placed by the respondent on "purchasing a 100% Zimbabwean brand" when purchasing new products	128	1	4	2.98	1.180
Value placed by the respondent on "purchasing an import" when purchasing new products	128	1	4	2.13	1.115
Value placed by the respondent on "product quality" when purchasing new products	128	2	4	3.50	.517
Value placed by the respondent on "market education/communication" when purchasing new products	128	2	4	3.65	.583
Value placed by the respondent on "brand originality" when purchasing new products	128	1	4	3.45	.895
Value placed by the respondent on "user friendliness" when purchasing new products	128	2	4	3.34	.553
Value placed by the respondent on "country of origin" when purchasing new products	128	1	4	3.34	.943
Value placed by the respondent on "product uniqueness" when purchasing new products	128	1	4	3.68	.742
Value placed by the respondent on "market access" when purchasing new products	128	1	4	3.78	.531

Overall mean = 3.24, s.d. = .796

A further statistical analysis was done to establish the overall mean and standard deviation of the attributes ranked. Table 6.12 above shows the summary of these statistics. From the table, it emerges that respondents place much value on "market access" when purchasing new products, with a mean of 3.78 (s.d =.531), while least value is put on "purchasing an import" (mean = 2.13, s.d. =1.115).

6.5.3 Institutes' views on Commercialization Determinants

In order to establish research institutes' views on what they feel facilitates commercialization, staff respondents were asked the extent to which they agree or disagree with statements developed to establish their views on the current state of commercialization. The table below shows the results.

It is evident from the results table that respondents disagree with the fact that their institutes obtain sectoral support (63.64% of the respondents disagree, compared to 21.21% who agree). The respondents also disagree that R & D (61.02%) and marketing (43.24%) staff are motivated, that the new products are easily accessible (45.71%) and that institutes engage in adequate test marketing of their innovations. Further, 50% of the respondents feel public awareness is adequate even though the majority (51%) remain neutral regarding locale awareness of their research institutes, 69.81% of the respondents fee; they did adequate market education and in the same vein, the majority (45,45%)

agree to the notion that information dissemination on new products is adequate. The mainstream respondents (52%) remain neutral with regards to new product development in Zimbabwe being technology-driven.

Table 6.13: Level of Institutional Agreement with Specified Notions

FACTOR			FREQUENCIES										
	Strongly Disagree		Disagree		Combined Disagree	Neutral		Agree		Strongly Agree		Combined Agree	Total
	N	%	N	%	%	N	%	N	%	N	%	%	N
Public Awareness	3	10.71 %	3	10.71%	21.43%	8	29%	5	17.86%	9	32.14 %	50.00%	28
Locale Awareness	7	12.28 %	7	12.28%	24.56%	29	51%	12	21.05%	2	3.51%	24.56%	57
Accessibility	8	22.86 %	8	22.86%	45.71%	7	20%	9	25.71%	3	8.57%	34.29%	35
Resource Commitment	7	13.46 %	7	13.46%	26.92%	8	15%	25	48.08%	5	9.62%	57.69%	52
Market Education	4	7.55%	4	7.55%	15.09%	8	15%	11	20.75%	26	49.06 %	69.81%	53
Training	10	18.18 %	10	18.18%	36.36%	10	18%	5	9.09%	20	36.36 %	45.45%	55
Test Marketing	14	22.58 %	14	22.58%	45.16%	11	18%	13	20.97%	10	16.13 %	37.10%	62
Technology Drive	3	6.82%	3	6.82%	13.64%	23	52%	9	20.45%	6	13.64 %	34.09%	44
Patent Protection	9	25.00 %	9	25.00%	50.00%	12	33%	3	8.33%	3	8.33%	16.67%	36
Information Dissemination	4	12.12 %	4	12.12%	24.24%	10	30%	12	36.36%	3	9.09%	45.45%	33
Government Support	7	20.59 %	7	20.59%	41.18%	13	38%	4	11.76%	3	8.82%	20.59%	34
R & D Staff Motivated	18	30.51 %	18	30.51%	61.02%	13	22%	6	10.17%	4	6.78%	16.95%	59
Marketing Staff Motivated	8	21.62 %	8	21.62%	43.24%	13	35%	3	8.11%	5	13.51 %	21.62%	37
Feedback use	7	16.28 %	7	16.28%	32.56%	13	30%	12	27.91%	4	9.30%	37.21%	43
Economic Support	9	23.68 %	9	23.68%	47.37%	4	11%	10	26.32%	6	15.79 %	42.11%	38
Sectoral Support	21	31.82 %	21	31.82%	63.64%	10	15%	5	7.58%	9	13.64 %	21.21%	66

6.6 CUSTOMER PERCEPTIONS ON ZIMBABWE'S INNOVATIONS

The other objective of the study was to determine customer perceptions on the state of innovations commercialization in Zimbabwe vis-à-vis their innovation expectations. In order to establish these perceptions, respondents were asked the extent to which they agreed or disagreed with statements developed to establish how they perceived Zimbabwe's innovations. The table below shows a summary of the statistical analyses done to establish the overall mean and standard deviation of the perceptions held by customers of the new products.

Table 6.14: Summary Statistics on Customer Perceptions of Zimbabwe's Innovations

Attribute	N	Minimum	Maximum	Mean	Std. Dev.	Skewness	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
Level of agreement with the notion that Zimbabwe's innovations are of high quality	130	1	5	4.08	1.205	-1.041	.212
Level of agreement with the notion that Zimbabwe's innovations are unique	130	1	5	4.54	1.171	-.812	.212
Level of agreement with the notion that Zimbabwe's innovations are original	130	1	5	3.98	1.333	-1.002	.212
Level of agreement with the notion that Zimbabwe's innovations are affordable	130	1	5	3.03	1.134	.004	.212
Level of agreement with the notion that Zimbabwe's research institutes give market support to their innovations	130	1	5	2.70	1.145	.552	.212
Level of agreement with the notion that Zimbabwe's innovations are easily accessible in the market	130	1	5	2.22	1.484	.707	.212
Level of agreement with the notion that Zimbabwe's innovations are safe	130	1	5	3.82	.821	-1.795	.212
Level of agreement with the notion that Zimbabwe's innovations are user-friendly	130	2	5	3.77	.699	-.754	.212
Level of agreement with the notion that Zimbabwe's innovations are well promoted / communicated	130	1	5	2.26	1.287	.904	.212
Level of agreement with the notion that the respondent prefers local innovations to imports	130	1	5	4.10	1.317	-1.283	.212
Valid N (listwise)	130						

Overall mean = 3.51, s.d. = 1.160

The above statistical diagnostic table shows that respondents generally agree that Zimbabwe's innovations are unique, as evidenced by a mean of 4.54 (s.d. = 1.171). It is also evident from the table that respondents do not agree with the notion that Zimbabwe's innovations are accessible (mean = 2.22; s.d. = 1.484) and that they are well promoted (mean = 2.26; s.d. = 1.287). Mixed perceptions surround the pricing issue as respondents remain neutral regarding the notion that Zimbabwe's innovations are affordable (mean = 3.03; s.d. = 1.134).

The responses on perceptual views are more negatively distributed given that about 60% of the perceptual attributes are negative (less than zero), thus the majority of the respondents seem to agree with the perceptions stated. This outcome is further strengthened by the average mean of the attributes (mean = 3.51; s.d. =1,160) which is biased towards moving from neutral (code 3) to agreeing (code 4) with most of the perceptual attributes.

6.6.1 Customer Expectations versus their Fulfillment

The perceptual perspectives obtained from the respondents were to be compared with the research institutes' capabilities in meeting the customer expectations. Thus respondents were asked the extent to which they felt their expectations were met. Figure 6.2 below shows the resultant outcome.

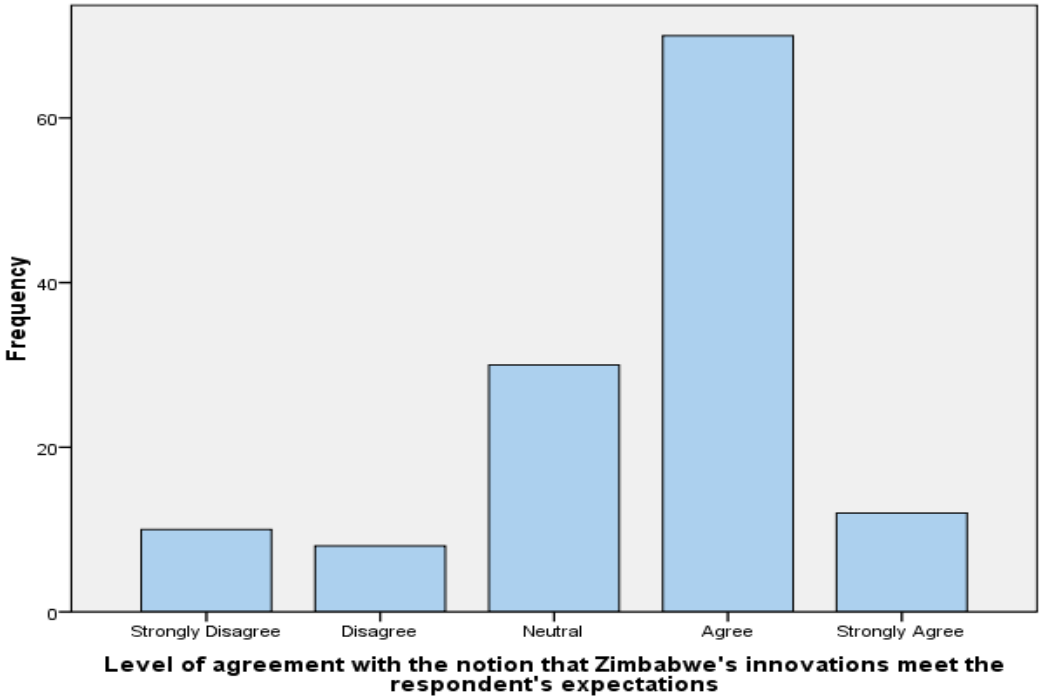

Figure 6.2: Level of Agreement with the Notion that Zimbabwe's Innovations meet Customer Expectations

The majority of the respondents (63%) agree that Zimbabwe's innovations meet their expectations. This is inconsistent with earlier ratings of the respondents in perceiving the same innovations as original and of high quality. The figure shows that while 14% feel their expectations are not met through the use of Zimbabwe's innovations, 23.1% of the respondents prefer to be neutral.

6.6.2 Perceptual Mapping

Given that the summary statistics on customer perceptions of Zimbabwe's innovations produced some mixed perceptual views, with an average mean of the attributes of 3.51 (s.d. =1,160) which is biased

towards positive perceptions moving from neutral views, a further analysis was done using the correspondence analysis technique in order to establish the accurate perceptions hence addressing the research question: *How do customers perceive Zimbabwe's local innovations vis-à-vis their innovation expectations?* In developing these perceptual maps, various cross tabulations were run on selected perceptual variables leading to perceptual map plots as illustrated in the tables and figures that follow.

Table 6.15: Correspondence Table on Expectations Fulfillment Levels and Age Group

Zimbabwe's innovations meet respondent's expectations	Age group of respondent					
	16 - 24 years	25 - 34 years	35 - 44 years	45 - 54 years	55 years or older	Active Margin
Strongly Disagree	5	0	0	2	3	10
Disagree	1	4	2	1	0	8
Neutral	5	11	8	2	4	30
Agree	9	18	14	13	16	70
Strongly Agree	0	5	2	4	1	12
Active Margin	20	38	26	22	24	130

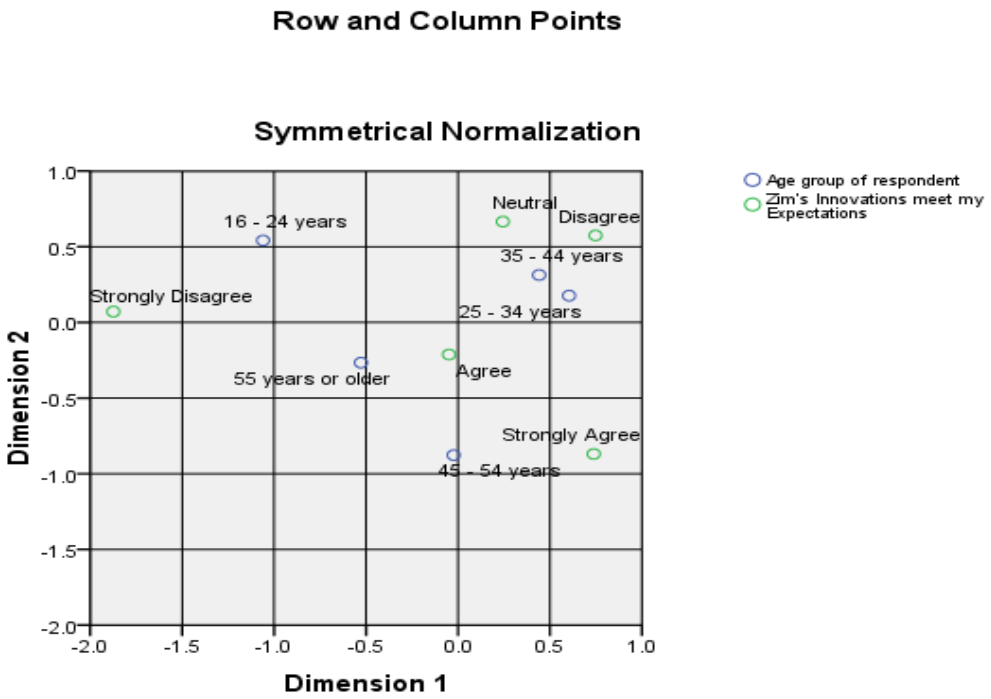

Figure 6.3: Perceptual Map on Customer Needs Fulfillment Levels Based on Age Group

The perceptual map above shows two main groups of thought. On the one hand, the younger age group (16–24 years) strongly disagrees that Zimbabwe's innovations meet their expectations while their fellow brethren in the 25–34 age group disagree with this. On the other hand, the older age groups, 55 years or older and 45–54 years are, respectively, more inclined to agree and strongly agree that the innovations meet their expectations. The middle age group (35–44 years) is closer to having neutral views.

Table 6.16: Correspondence Table on Quality Perceptions and Consumer Preferences

Agreement with "Prefers Local Innovations to Imports"	Agreement with "Zimbabwe's Innovations are of High Quality"					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Active Margin
Strongly Disagree	0	5	11	6	0	22
Disagree	4	1	0	6	0	11
Neutral	0	8	21	7	3	39
Agree	1	12	6	10	15	44
Strongly Agree	4	0	14	23	225	266
Active Margin	9	26	52	52	243	382

In order to visualize the cross tabulation in the table above, the plot in Figure 6.4 below is used as a perceptual map.

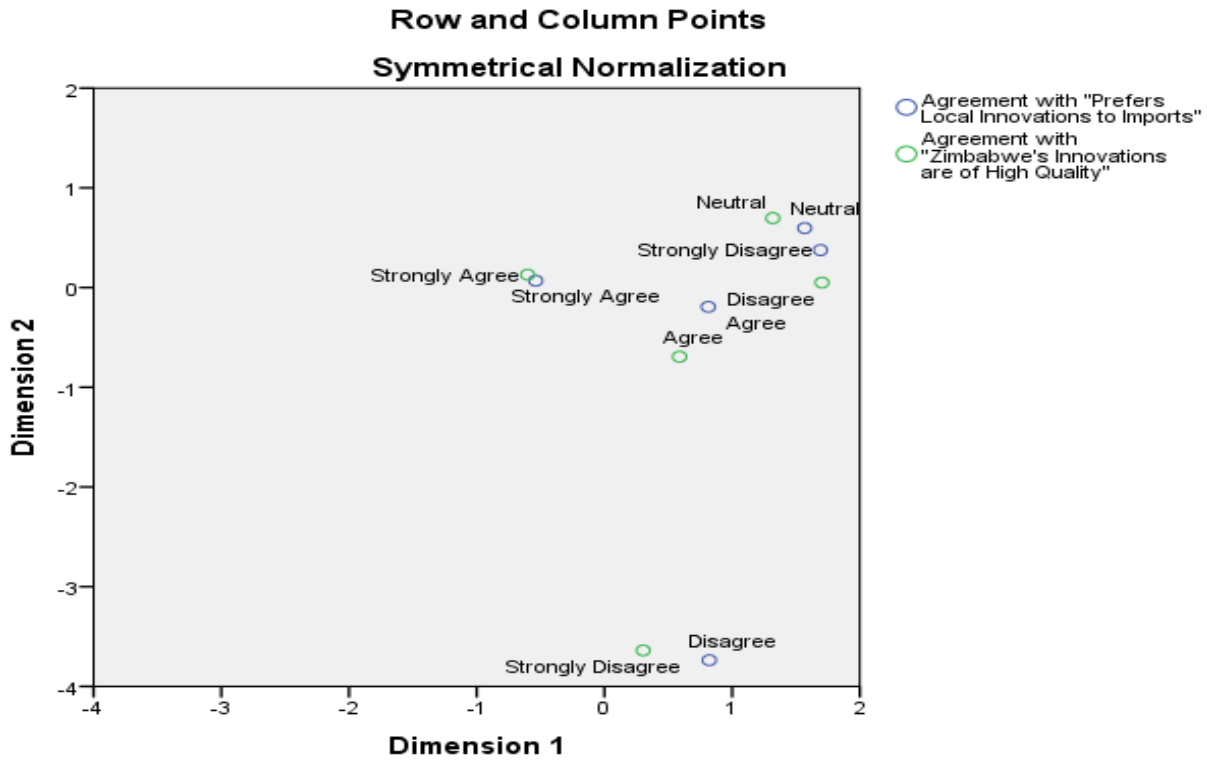

Figure 6.4: Perceptual Map on Quality versus Consumer Preferences

There are two groups of thought here. Those who disagree that there is preference for local innovations as opposed to imports also strongly disagree that Zimbabwe's innovations are of high quality. The other group has those who are neutral to the far extreme while those who strongly agree to both notions are more to the centre zero on both dimensions. Those who strongly agree that there is preference of local innovations to imports also strongly agree that Zimbabwe's innovations are of high quality. The distance between these two is quite small, implying that they move together, i.e. they are closely related.

Table 6.17: Correspondence Table on Quality Perceptions versus Economic Well-being

Economic Well-being	Agreement with "Zimbabwe's Innovations are of High Quality"					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Active Margin
Poor	0	4	0	0	0	4
Below average	0	4	15	6	3	28
Average	4	18	31	32	102	187
Above average	5	0	6	5	138	154
Flourishing	0	0	0	9	0	9
Active Margin	9	26	52	52	243	382

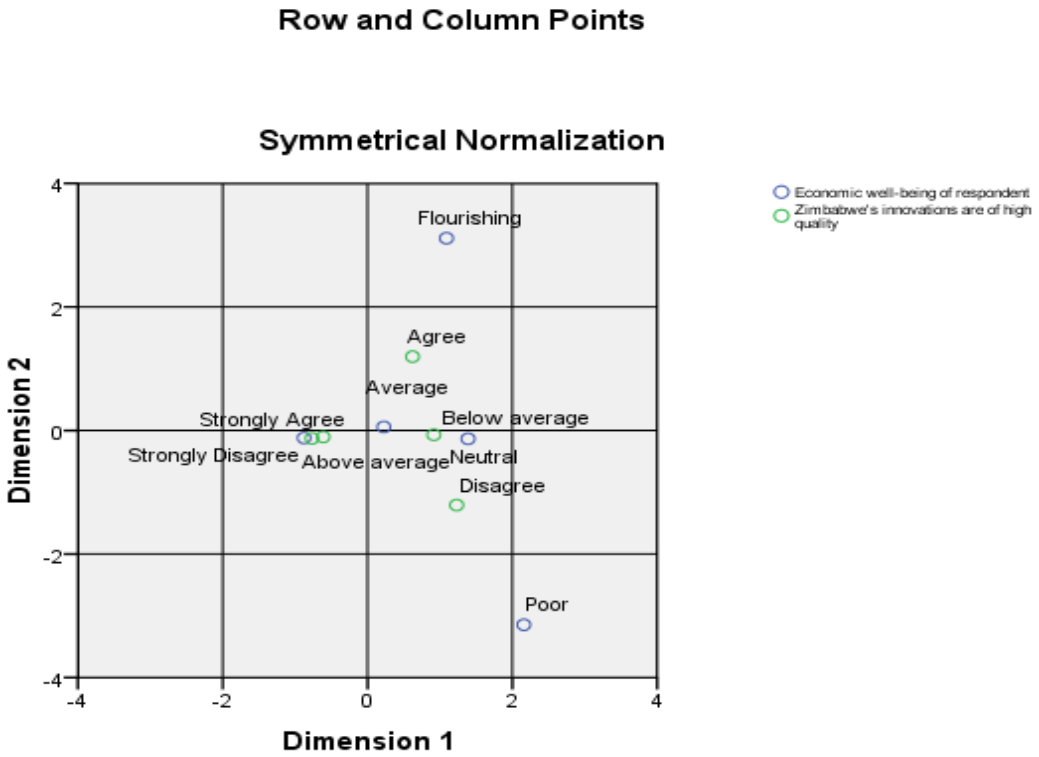

Figure 6.5: Perceptual Map on Quality versus Economic Well-being

The respondents whose economic well-being is flourishing seem to agree that Zimbabwe's innovations are of high quality while the poor disagree. The map, however, shows an interesting trend where those whose economic well-being is described as above average strongly agree while others within the same economic class strongly disagree, hence there is a group with mixed perceptions. The below average class' perceptions are rather neutral.

Table 6.18: Correspondence Table on Quality Perceptions Based on Purchase Frequency

Purchase Frequency	Level of agreement with the notion that Zimbabwe's innovations are of high quality					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Active Margin
Frequently	0	0	0	2	3	5
Once in a month	0	0	0	0	0	0
Once in a year	0	1	3	7	0	11
Only when need arises	3	12	13	12	65	105
When I just come across the New Product	0	0	4	0	3	7
Active Margin	3	13	20	21	71	128

In order to visualize the cross tabulation in the table above, the plot in Figure 6.6 below is used as a perceptual map.

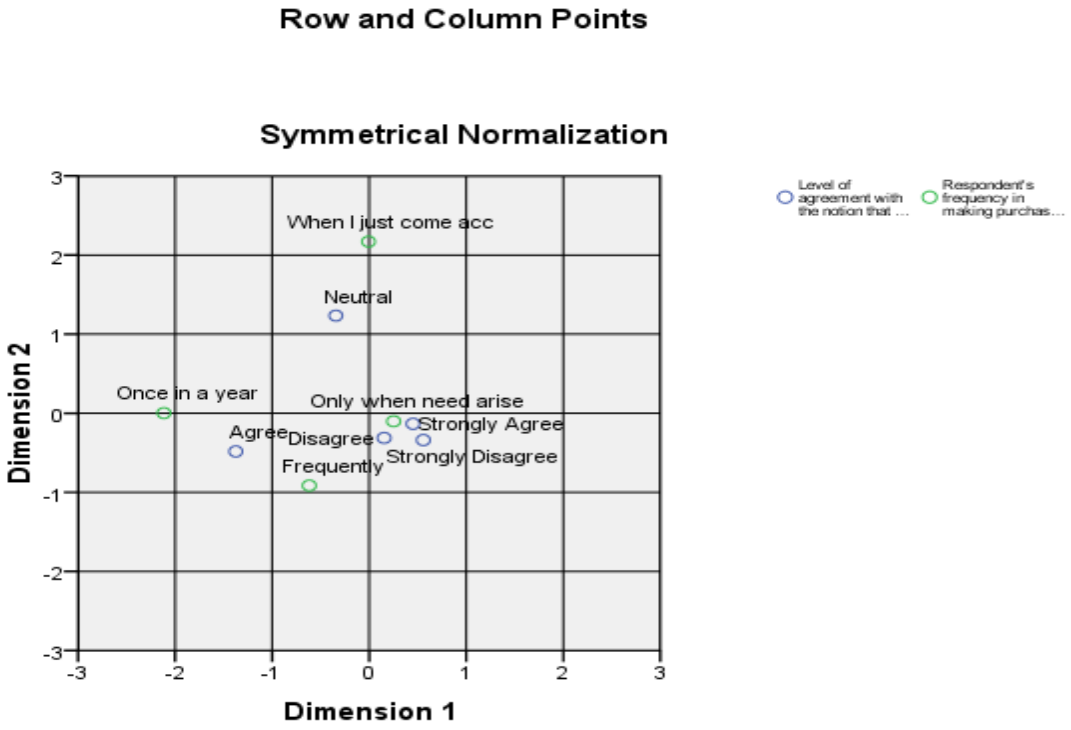

Figure 6.6: Perceptual Map on Quality Based on Purchase Frequency

From the figure above, there is an evident tendency to cluster around zero on dimension 2 while there is a relationship between those who say they purchase "when they just come across the product" and neutrality on the notion that Zimbabwe's innovations are of high quality. Frequent purchasers of Zimbabwe's innovations are closer to agreeing that Zimbabwe's innovations are of high quality.

Table 6.19: Correspondence Table on Commercialization State Perceptions versus Local Product Preferences

Local Preference	State of Commercialization					
	Poor	Average	Above average	Good	Excellent	Active Margin
Strongly Disagree	3	3	0	0	2	8
Disagree	2	8	2	0	0	12
Neutral	2	2	0	2	1	7
Agree	9	6	18	0	0	33
Strongly Agree	3	6	0	0	0	9
Active Margin	19	25	20	2	3	69

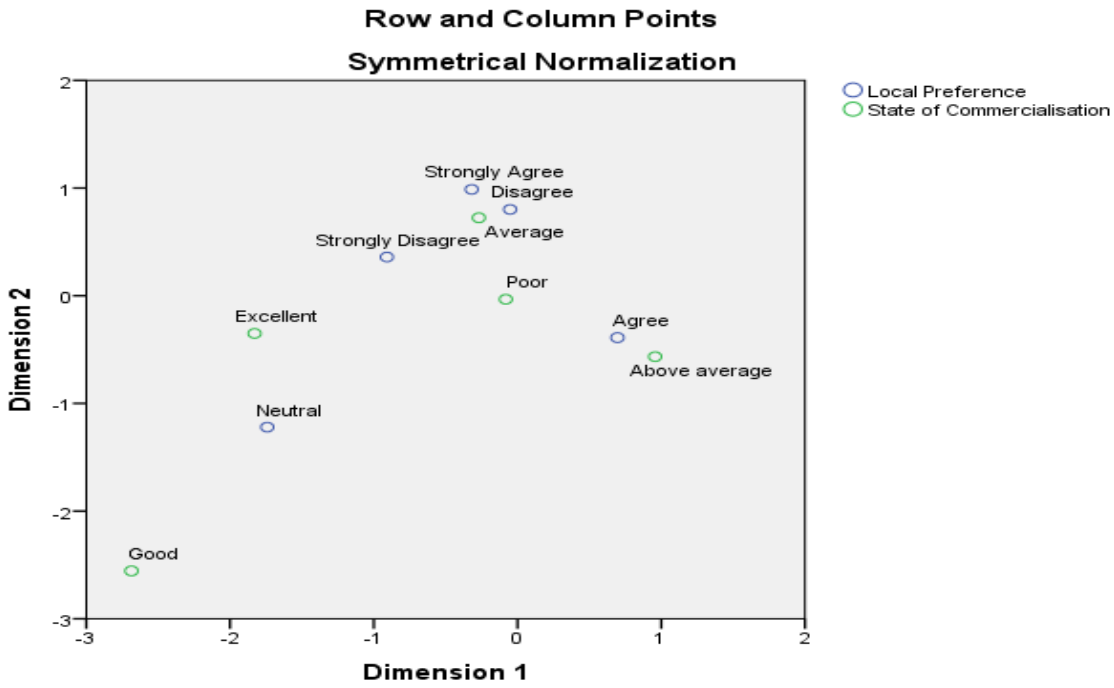

Figure 6.7: Perceptual Map on Commercialization State Perceptions versus Preferences

Figure 6.7 shows that those who disagree and strongly disagree or strongly agree that there is preference of local innovations to imports have an average rating of the "average" state of commercialization. Those who are neutral in terms of local innovations preference to imports are closer to an "excellent" rating of the ultimate state of commercialization than they are to a rating of "good".

6.7 THE ROLE OF PPPs IN COMMERCIALIZATION OF TIs: PRESENTATION OF QUALITATIVE DATA

This section summarizes the qualitative phase of the study which comprised of some interview series that were aimed at inductively exploring the role of Private-Public Partnerships (PPPs) in the commercialization of technological innovations. In order to explore this role, there was a need to first establish if any PPPs existed in the research institutes, the general understanding of PPPs as well as how they should operate, among other issues – and this justified the need for interviews. Of the intended six, five in-depth interviews were conducted with management staff from research institutes who permitted such interviews to be held. Proper procedures and ethical guidelines were followed in line with good research practices. SPSS Text Analytics was used to analyze the qualitative data.

The five interviewees who emerged are from diverse backgrounds and at varying organizational positions, coming from different research institutes. The table below fully profiles the interviewees.

Table 6.20: Profile of the Interviewees

Factor	Frequency	Percentage
Gender of Interviewee		
Male	4	80.0
Female	1	20.0
Total	5	100.0
Sector of Interviewee's Institute		
Public	3	60.0
Private	2	40.0
Total	5	100.0
Experience with Research Institute		
5 years	2	40.0
7 years	1	20.0
10 years	1	20.0
13 years	1	20.0
Total	5	100.0
Interviewee's Background		
Sales and Marketing	1	20.0
Production	1	20.0
Business Development	2	40.0
Technical	1	20.0
Total	5	100.0

The profiling evidently shows that the interviewees are dominantly male and the majority (60%) are from the public sector even though the sample had initially been intended to be a 50-50 distributed interview sample. All interviewees have at least five years of experience within their respective institutes, with the majority (40%) coming from a business development background. The open interviews' responses, based on cross-case analysis (Patton, 1990), were thematically grouped, i.e. they were clustered into themes surrounding the role played by PPPs in commercializing technological innovations.

6.7.1 Risk Sharing

All five respondents identify "sharing innovation development and management-related risk" as the major "benefit" they get or are likely to obtain through PPPs. All interviewees in the sample see PPPs as vehicles through which costs, responsibilities and innovation risks can be shared together with the benefits that come through the alliances. Thus responses such as the following were common:

> *We share the expenses related to the partnership, the risks we bear together. Of course depending on the nature of the agreement, in some cases we get sponsors who fund everything from the new product development right through to commercialization – something we cannot afford to get when we operate on our own. Such sponsors seem to have (more) faith in alliances than individual institute projects.*

6.7.2 Product Knowledge Sharing and Information Dissemination

Almost all of the interviewees (5 out of 6) refer to the "joy of seeing an innovation sailing through the market" and the need to "get the technological innovation out of the research institute." Other responses varied from "seeing our technological breakthrough being used as new products," to "getting our new technologies to the market." Hence the majority of the interviewees see the organization of PPPs as an imperative move for Research & Development – and Commercialization (R & D – C) of TIs. The interview participants state that these alliances in form of PPPs "increase the visibility of the new product." They perceive a PPP as "an essential path" for sharing and disseminating information on the new TIs – their application and how to access them:

> *We perform research all year round, we convert ideas into concepts and into final products…and…this isn't enough…I think we can get much more mileage out there if we can get support from other parties. They can spread the word within their areas of influence, within their means – we do the same…our combined marketing efforts are better than our own individual efforts.*

Alliances, especially those that include international partners, are said to be more lucrative and ideal in enhancing "international exposure" and "international recognition" of Zimbabwe's innovations. For example, a participant [4] from a public coffee research institute from the Eastern Highlands explains:

> *My institute has partnered with some bodies from India, Germany, Uganda, Kenya, Rwanda and Brazil. Through these relationships, we have engaged in some exchange programmes, we have been called to participate and showcase our output in international conferences and*

> *exhibitions…and we now have affiliation to international professional bodies that govern our business conduct. These have helped strengthen our international ties while improving our market base coverage.*

This expression clearly shows an excitement with international collaborations at the expense of the local PPPs, which most interviewees describe as "weak" and "not reaping much of the expected outcomes".

6.7.3 PPPs Improve Economic Competitiveness

Another common role that emerged (4 respondents) is that interviewees strongly feel that PPPs help in improving the economic competitiveness of the nation as a whole. This, the interviewees said, can be enhanced through PPPs' ability to modernize national infrastructure. For instance, one respondent stresses that:

> *Indeed, PPPs help in resolving national problems. Take for instance, the E10 fuel PPP which saw the erection of the gigantic ethanol plant in Chisumbanje, how many jobs has it created? How many living standards have the structure improved? How many access roads have roads have been constructed? What about houses…?*

In support of this opinion, another respondent echoes:

> *Of course we have a lot to gain than to lose with these alliances. You see when we engage in these alliances, in most cases we erect structures for production, sales and marketing, administration etc. hence employment is created, living standards are improved; peoples' tastes improve as they move along with technology. This means our new technologies' market uptake improves as well.*

The above views show a positive relationship between economic competitiveness and the uptake of the research institutes' technologies. The relationship is however enhanced through infrastructural development.

6.7.4 PPPs enhance Demand-driven Research

It emerged that "properly formulated and effective" PPPs facilitate the introduction of demand-driven technologies, "with a ready market". One respondent was quoted as saying:

> *With a properly organized PPP, institutes are assured of funding and market as the parties make a combined effort to ensure they introduce only what is required by the market and that which meets industry's demands. This way we avoid 'academic research' with no 'takers'.*

Asked how PPPs could be "properly organized" and be "effectively run", almost all interviewees highlight the need for adequate funding, ensuring national political stability, proper communications between parties to the alliance, creation of platforms where issues can be raised and discussed (stakeholder consultation forums) as well as the need for appointing of a "referee" to coordinate the PPP activities. The "referee" appointment issue raises so much interest such that one participant is very defensive about it:

> *Most PPPs in Zimbabwe have failed because they do not have a 'referee.' They just do things anyhow…. There is need for a referee e.g. in form of a PPP steering committee with representatives from the Funders or Donors of the alliance, supervisory body, executing agent, implementing agent (the research institute, in this case).*

Another interviewee [2], a business development manager adds:

> *… there is also need for periodic progress reports in which issues relating to progress achieved, challenges faced and the future of the alliance, should be deliberated against work plans agreed upon.*

6.7.5 Avoidance of Technology Duplication

It also emerged from the interviews that PPPs, if "properly run" can go a long way in avoiding duplication of technology amongst both public and public research institutes thus ensuring efficient allocation of the nation's "scarce resources". Thus two of the interviewees from the private sector feel that combined efforts from the PPP players could result in a unique technological innovation, in a better form, compared to two "otherwise similar technologies emanating from the research institutes as separate players".

6.7.6 Enhancement of Capacity Building

Two of the interviewees, from each of the two sectors (public and private), support the view that PPPs facilitate capacity building projects for their respective institutes. This capacity building, according to the respondents, is prevalent in the areas of "product standardization, certification, verification and sustainability" thus "one player's weaknesses are strengthened the other players' areas of strengths as the PPP players complement each other in terms of skills – from production right through to post-sales skills…"

6.7.7 PPPs as Innovation Policy Tools

Grounded on the belief that private players are indeed "superior to the public sector in efficient resource allocation" (Oblak, Bistričić & Jugović, 2013), one influential participant [1] from the private sector notes:

...PPPs allow the quality and cost of new technologies to be benchmarked against the prevailing standards on the local, regional and on international markets. With combined resources, skills and effort such benchmarking becomes very possible and this, in turn, helps in ensuring effectiveness and efficiency in all processes.

The interviewee further emphasizes that:

It is of great significance to create and maintain sustainable relationships if successful marketing efforts for any new product are to be fruitful...PPPs serve well in fulfilling this requirement in commercialization policy making...

The table below summarizes the main PPP roles that emerged from the interviews, together with other roles that arose, which were thematically organized.

Table 6.21: Summary of the roles of PPPs in Commercialization

Main Roles arising	Other Roles
➲ Risk Sharing ➲ Product Knowledge Sharing and Information Dissemination ➲ PPPs Improve Economic Competitiveness ➲ PPPs enhance Demand-driven Research ➲ Avoidance of Technology Duplication ➲ Enhancement of Capacity Building ➲ PPPs as a policy tool	➲ Faster and Improved Project Delivery ➲ Use of Private Sector Expertise ➲ PPPs Drive Innovation ➲ Economy Sustainability ➲ Enhanced new product exposure through local, regional and international affiliations ➲ Enable formation of informal networks which facilitate formal relationships development, hence enhancing licensing arrangements with established firms

Asked about the perceived level of general public awareness surrounding the existence of some PPPs in Zimbabwe, the majority of the participants (3 out of 5) feel strongly that the general public is not very aware of the existence of PPPs in Zimbabwe, "save for a few". The respondents refer to what they describe as "constituencies" rather than the public. For instance, they refer to the "coffee constituency, for Coffee research institutes – composed of coffee farmers, farmer field schools, coffee consumers etc", so it appeared some of the research institutes have a certain targeted communities which they deal with. Thus one interviewee states:

...regarding the general public, some might be aware and some might not be aware of the existence of public-private-partnerships....so it's a mixed pot where some institutes make efforts to create that "awareness" you are asking about, some do not make such efforts – some decide to, but some do not just have the resources to do so even though they have the desire.

This expression leaves a lot of questions. It represents a mixed group in terms of the levels of awareness of the PPP developments taking place within communities, something that probably defeats the overall desire of any scientist to see their output through to the community. However, the participant raises an important determinant of creating the much needed awareness – resources, either financial, material or human resources.

6.8 ROAD MAP - MODEL PRINCIPAL COMPONENTS ANALYSIS

The ultimate objective of the study was to develop a roadmap as an intervention tool in policy-making as a way forward based on the research findings. This involved model development, testing and finalization. Thus the variables to form the roadmap were screened using the Principal Component Analysis (PCA) technique whereby redundant variables were removed ensuring that more variability is explained by a small number of variables. This technique is commonly known as "variable reduction technique" (Hatcher, 1994; Jolliffe, 1972). The technique "maximizes the amount of variance accounted for, in the observed variables by a smaller group of variables" (Jolliffe, 1972: 161). These smaller groups of variables are called components and they are the basis of constructing the roadmap in fulfilling the last objective of this study**.**

6.8.1 Measurement Development and Modification

In order to develop measurements for the model constructs, some interrelated statistical techniques were used to analyze the model preparatory data. For brevity, the Cronbach's alpha that appears in the PCA output is quoted as the measure of the reliability or internal consistency of the Likert scale used in each of the questions or variables. This section thus looks at the reliability scores for the constructs (construct reliability) enhanced by relevant factor analyses and these are used to determine whether each examined variable should be retained or be excluded in the model.

6.8.1.1 Customer Attributes

Table 6.22*a*: Output from Initial PCA: Customer Preferences

	Centroid Coordinates			Total (Vector Coordinates)		
	Dimension			Dimension		
	1	2	Mean	1	2	Total
Prefers Local to Imports	.387	.271	.329	.383	.265	.648
High Quality Innovations	.712	.179	.446	.705	.129	.833
Innovations are Unique	.731	.137	.434	.721	.095	.816
Innovations are Original	.515	.178	.347	.513	.147	.661
Innovations are Affordable	.418	.233	.325	.161	.173	.334
RI give Support to Innovations	.578	.144	.361	.477	.104	.582
Innovations are Market-driven	.365	.313	.339	.299	.229	.528
Technology-driven Innovations	.707	.147	.427	.665	.074	.740
Easily Accessible on the Market	.721	.142	.432	.717	.001	.719
Innovations are Safe	.301	.599	.450	.167	.530	.697
Innovations are User Friendly	.372	.767	.570	.087	.738	.825
Well Promoted/ Communicated	.829	.273	.551	.823	.018	.841
Knows where to Buy and / or check for New Products	.621	.252	.436	.581	.037	.618
Meet Respondent's Expectations	.382	.518	.450	.069	.499	.568
Active Total	**7.640**	**4.154**	**5.897**	**6.369**	**3.040**	**9.409**
% of Variance	54.573	29.671	42.122	45.493	21.711	67.204
Construct Composite Reliability .962 based on Eigen value						

After removing the highlighted variables (Local Preference, Originality, Affordability and Market drive) that seemed insignificant (cut off mean value = 0.350), the Cronbach's Alpha improved by 0003 to 0.965 from the initial 0.962 above. Further, the amount of variance (77.92%) explained by the principal components is greater than the variance explained by all the variables of 67.2%.

Table 6.22*b*: PCA Output After Removal of Insignificant Variables: Customer Preferences

	Centroid Coordinates			Total (Vector Coordinates)		
	Dimension			Dimension		
	1	2	Mean	1	2	Total
Innovations are of High Quality	.628	.329	.479	.602	.277	.879
Innovations are Unique	.646	.319	.483	.627	.268	.895
Technology-driven Innovations	.777	.137	.457	.755	.014	.769
Innovations are Easily Accessible on the Market	.744	.154	.449	.736	.035	.771
Innovations are Safe	.366	.639	.503	.208	.577	.786
Innovations are User Friendly	.415	.736	.576	.142	.679	.821
Innovations are Well Promoted/ Communicated	.836	.344	.590	.814	.051	.865
Knows where to Buy and/ or Check for New Products	.611	.278	.445	.586	.060	.647
Innovations meet Respondent's Expectations	.379	.503	.441	.121	.460	.580
Active Total	**5.403**	**3.439**	**4.421**	**4.592**	**2.421**	**7.013**
% of Variance	60.031	38.209	49.120	51.017	26.904	77.921
Construct Composite Reliability .965 based on Eigen value						

Table 6.23*a*: Output from Initial PCA: Price

	Centroid Coordinates			Total (Vector Coordinates)		
	Dimension			Dimension		
	1	2	Mean	1	2	Total
Low Price	.465	.262	.363	.415	.212	.627
Purchasing a 100% Zimbabwean Brand	.736	.115	.425	.732	.005	.737
Purchasing an Import	.561	.140	.351	.561	.110	.670
Product Quality	.538	.017	.278	.535	.002	.538
Market Education/ Communication	.238	.448	.343	.129	.408	.537
Brand Originality	.424	.026	.225	.412	.021	.433
User Friendliness	.382	.332	.357	.352	.328	.680
Country of Origin	.543	.021	.282	.541	.020	.561
Product Uniqueness	.480	.208	.344	.472	.100	.572
Market Access	.308	.395	.351	.301	.381	.682
Active Total	**4.673**	**1.964**	**3.319**	**4.451**	**1.586**	**6.037**
% of Variance	46.732	19.643	33.188	44.509	15.864	60.372
Construct Composite Reliability .927 based on Eigen value						

Below are the results after the exclusion of highlighted variables. Reliability remains within the same range of .917 but the Eigen value improves significantly from 60.372 to 66.739.

Table 6.23*b*: PCA Output After Removal of Insignificant Variables: Price

	Centroid Coordinates			Total (Vector Coordinates)		
	Dimension			Dimension		
	1	2	Mean	1	2	Total
Low Price	.564	.235	.400	.517	.164	.680
Purchasing a 100% Zimbabwean Brand	.657	.145	.401	.655	.002	.658
Purchasing an Import	.642	.093	.368	.642	.064	.705
Market Education/ Communication	.299	.495	.397	.198	.450	.648
User Friendliness	.475	.258	.367	.454	.255	.709
Product Uniqueness	.430	.243	.337	.427	.112	.539
Market Access	.279	.477	.378	.270	.464	.733
Active Total	3.347	1.947	2.647	3.162	1.510	4.672
% of Variance	47.811	27.816	37.813	45.168	21.571	66.739
Construct Composite Reliability .917						

These variables remaining in the final Principal Component Analysis were used to construct the roadmap for the study.

6.8.1.2 Research Institutes' Attributes

The Cronbach's Alpha value of 0.954 is acceptable. In this case, the total variance accounted for is 57.612% (Total Eigen Value = 9.794) divided by the Number of Variables [17] multiplied by 100%). Using Table Table 6.24a with variance accounted for below, any variable with a mean less than 0.350 is removed because it is considered that, in this situation, it is not suitably contributing to the principal components.

Table 6.24*a*: Output from Initial PCA: Research Institutes' Factors

Attributes	Centroid Coordinates			Total (Vector Coordinates)		
	Dimension			Dimension		
	1	2	Mean	1	2	Total
Local Preference	.458	.101	.279	.362	.001	.363
Public Awareness	.612	.389	.501	.503	.288	.791
Location Awareness	.554	.157	.356	.419	.116	.535
Accessibility	.582	.299	.440	.458	.177	.635
Resource Commitment	.393	.588	.490	.017	.359	.376
Market Education	.269	.417	.343	.262	.411	.673
Training	.136	.502	.319	.064	.497	.560
Test Marketing	.743	.094	.419	.741	.018	.760
Technology	.275	.479	.377	.158	.367	.524
Patent Protection	.389	.084	.237	.344	.057	.401
Information Dissemination	.642	.288	.465	.578	.075	.653
Government Support	.516	.170	.343	.438	.052	.491
R&D Staff Motivated	.234	.278	.256	.230	.266	.496
Marketing Staff Motivated	.236	.495	.365	.180	.448	.628
Use of Feedback	.280	.522	.401	.100	.410	.510
Economic Support	.562	.200	.381	.390	.135	.525
Sectoral Support	.671	.231	.451	.664	.209	.873
Active Total	**7.552**	**5.296**	**6.424**	**5.910**	**3.884**	**9.794**
Construct Composite Reliability .954						

The variables R&D Staff motivated, Government gives adequate support, Patent Protection, Market Education, and Market Preferences are removed. A re-run without these variables is done.

After a re-run, the Cronbach's Alpha (0.947) is obtained and is still above the lower acceptable limit of 0.7 used in this study (Drucker-Godard *et al.*, 2001).

Table 6.24*b*: PCA Output after Removal of Insignificant Research Institutes' Variables

	Centroid Coordinates			Total (Vector Coordinates)		
	Dimension			Dimension		
	1	2	Mean	1	2	Total
Public Awareness	.784	.164	.474	.755	.047	.801
Location Awareness	.622	.065	.344	.567	.001	.568
Accessibility	.684	.112	.398	.649	.006	.656
Resource Commitment	.486	.449	.468	.016	.400	.416
Training	.044	.539	.292	.001	.528	.529
Test Marketing	.526	.312	.419	.500	.263	.763
Technology	.441	.396	.419	.387	.143	.529
Information Dissemination	.630	.249	.439	.593	.031	.624
Marketing Staff Motivated	.520	.313	.417	.501	.204	.705
Use of Feedback	.424	.383	.403	.359	.157	.516
Economic Support	.434	.473	.453	.164	.459	.623
Sectoral Support	.282	.620	.451	.260	.610	.870
Active Total	**5.877**	**4.076**	**4.976**	**4.752**	**2.849**	**7.601**
Construct Composite Reliability .947						

In Table 6.24b above, the variance accounted for by the twelve variables is 63.342% which has been maximized by removal of five redundant variables. In order to determine the number of dimensions to use in the PCA, correlations of transformed variables were used. Table 6.25 summarizes these correlations. The Correlations Transformed Variables (presented in figure 6.25 below) refer to the variables formed after missing values have been imputed with the mode of the quantified variable. They are the correlation matrix after optimal scaling has taken place and this is the matrix used for the PCA in this study.

Table 6.25: Correlations of Transformed Variables

	Public Awareness	Location Awareness	Accessibility	Resource Commitment	Training	Test Marketing	Technology	Information Dissemination	Marketing Staff Motivated	Use of Feedback	Economic Support	Sectoral Support
Public Awareness	1.000	.702	.677	.309	.241	.461	.511	.643	.659	.466	.220	.262
Location Awareness	.702	1.000	.589	.096	.016	.422	.345	.398	.551	.350	.266	.281
Accessibility	.677	.589	1.000	.316	.067	.466	.478	.568	.463	.382	.373	.212
Resource Commitment	.309	.096	.316	1.000	.480	-.273	.087	.091	.211	.070	-.233	-.338
Training	.241	.016	.067	.480	1.000	-.356	.209	-.008	.143	.226	-.300	-.482
Test Marketing	.461	.422	.466	-.273	-.356	1.000	.263	.626	.264	.320	.507	.675
Technology	.511	.345	.478	.087	.209	.263	1.000	.299	.694	.531	-.038	.060
Information Dissemination	.643	.398	.568	.091	-.008	.626	.299	1.000	.373	.352	.322	.538
Marketing Staff Motivated	.659	.551	.463	.211	.143	.264	.694	.373	1.000	.677	-.112	.028
Use of Feedback	.466	.350	.382	.070	.226	.320	.531	.352	.677	1.000	-.061	-.084
Economic Support	.220	.266	.373	-.233	-.300	.507	-.038	.322	-.112	-.061	1.000	.669
Sectoral Support	.262	.281	.212	-.338	-.482	.675	.060	.538	.028	-.084	.669	1.000
Dimension	1	2	3	4	5	6	7	8	9	10	11	12
Eigen value	4.690	2.808	1.203	.688	.584	.536	.495	.340	.248	.182	.127	.099

a. Missing values were imputed with the mode of the quantified variable.

Notably, the Eigen values for the first two dimensions appear to be the most significant ones as compared to the Eigen value of the third dimension. However, since the Eigen value for dimension 3 is greater than 1 (Quinn and Keough, 2002), it would be reasonable to consider what happens when three dimensions are chosen. For the purposes of this study, two dimensions have been chosen.. With an acceptable value for the Cronbach's Alpha, the variance accounted for is 43.833%.

Table 6.26*a*: Output from Initial PCA: Commercialization Hindrances

	Centroid Coordinates			Total (Vector Coordinates)		
	Dimension			Dimension		
	1	2	Mean	1	2	Total
Demand-Pull	.162	.265	.214	.161	.196	.357
Technical Excellence	.292	.552	.422	.186	.508	.694
Time Lags	.506	.177	.342	.506	.066	.572
Follow Ups	.265	.448	.357	.056	.441	.497
Technological Infrastructure	.073	.458	.266	.068	.453	.521
Biased Funding	.214	.120	.167	.189	.119	.308
Resource Unavailability	.239	.496	.367	.204	.493	.697
Remuneration	.270	.037	.154	.221	.032	.253
Management Flows	.523	.004	.264	.523	.001	.525
Costs	.262	.067	.164	.229	.035	.264
Patent Laws	.132	.010	.071	.130	.003	.133
Active Total	2.938	2.634	2.786	2.475	2.347	4.822
% of Variance	26.714	23.948	25.331	22.496	21.338	43.833
Construct Composite Reliability .872						

In the above table, if the mean is 0.200, then the variable is removed. This implies Biased Funding, Remuneration, Costs, and Patent Laws are the variables to be removed. The effect has been to increase the amount of variance accounted for by the variables to 59.894% with an improved Cronbach's Alpha value of 0.888.

Table 6.26*b*: PCA Output After Removal of Insignificant Variables: Commercialization Hindrances

	Centroid Coordinates			Total (Vector Coordinates)		
	Dimension			Dimension		
	1	2	Mean	1	2	Total
Demand-Pull	.283	.234	.258	.208	.229	.436
Technical Excellence	.556	.335	.445	.522	.277	.799
Time Lags	.237	.494	.365	.074	.489	.563
Follow Ups	.473	.219	.346	.452	.101	.552
Technological Infrastructure	.458	.071	.265	.458	.070	.528
Resource Unavailability	.522	.351	.437	.521	.304	.825
Management Flows	.003	.489	.246	.001	.489	.490
Active Total	2.532	2.192	2.362	2.234	1.958	4.193
% of Variance	36.172	31.312	33.742	31.917	27.977	59.894
Construct Composite Reliability .888						

Once again, in order to determine the number of dimensions to use in the PCA, correlations of transformed variables were used. Table 6.27 below summarizes these correlations The Eigen values from dimension 3 onwards are insignificant since they are less than 1. Therefore, two dimensions (Dimensions 1 and 2) are considered.

Table 6.27: Correlations of Transformed Variables

	Demand-Pull	Technical Excellence	Time Lags	Follow Ups	Technological Infrastructure	Resource Unavailability	Management Flows
Demand-Pull	1.000	-.099	.291	-.362	.233	-.023	-.206
Technical Excellence	-.099	1.000	.178	.300	-.187	.775	-.208
Time Lags	.291	.178	1.000	-.270	.316	.076	-.324
Follow Ups	-.362	.300	-.270	1.000	-.397	.151	.112
Technological Infrastructure	.233	-.187	.316	-.397	1.000	-.340	-.116
Resource Unavailability	-.023	.775	.076	.151	-.340	1.000	-.309
Management Flows	-.206	-.208	-.324	.112	-.116	-.309	1.000
Dimension	1	2	3	4	5	6	7
Eigen value	2.234	1.958	.804	.692	.616	.541	.155

6.9 THE ROADMAP USING AMOS

In addition to showing the combination of variables that are critical in ensuring the successful commercialization of the Zimbabwe Research Institutes' technological innovations, this roadmap will be used to assess the role played by PPPs and commercialization commitment. Also, the magnitude and direction of the regression weights are discussed in relation to the role they play in the commercialization of TIs.

6.9.1 The Initial Model

The error variance term *e1* for Sectoral Support was negative (-6.573). This made the solution inadmissible. A negative variance of error terms reflects a very serious problem with the model (Byrne, 3013; Bentler and Chou, 1987). Thus the error had to be corrected. The error term *e1* was constrained to 1. It could not be removed because removing it would be like "removing the symptom which does not cure the disease".

In the path diagram representing the proposed model below, the regression weights 1.24 and 1.08 may also suggest the presence of multicollinearity in the data whereby some explanatory variables themselves are related. An attempt was made to see what would happen when one of them was removed. The independent variable Economic Support was removed. This is embedded in sectoral support, in a sense. This had the effect of reducing the regression weight 1.24 to 1.15 and also improving estimates for other independent variables. It is evident that sectoral support is the one most influenced by PPPs.

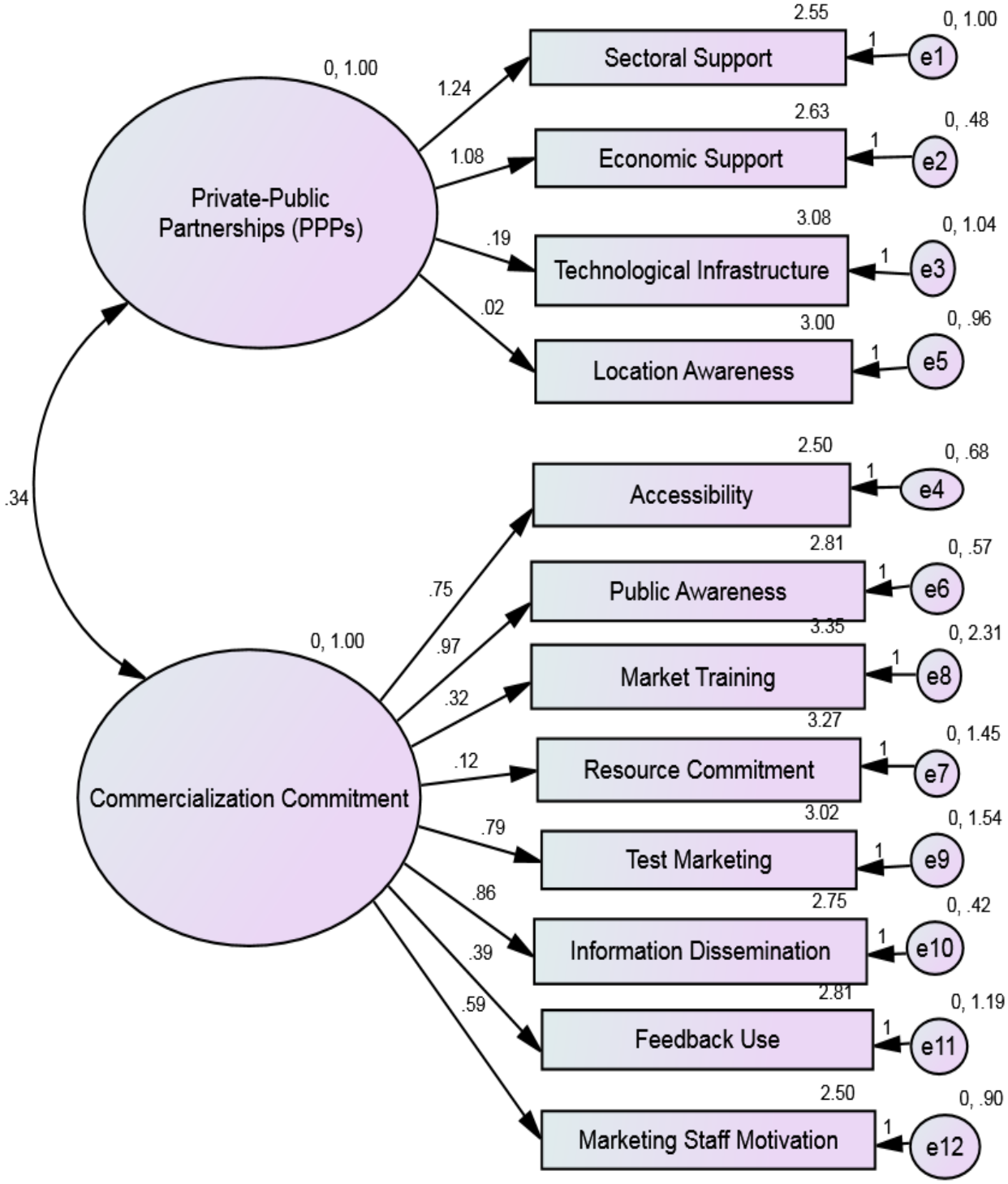

Figure 6.8: Initial Model for the Study

Source: ***Designed by the researcher***

A further analysis was done to establish the regression weights of each variable contributing to the model. This was done through the Bayesian Structural Equation Modelling (SEM)**.** The results are presented in the table below.

Table 6.28: Bayesian Structural Equation Modelling (SEM) for the Initial Model

Regression weights	Mean	S.E.	S.D.	C.S.	Median	95% Lower bound	95% Upper bound	Skewness	Kurtosis	Min	Max
Market Training<--Commercialization Commitment	0.353	0.006	0.287	1.000	0.350	-0.201	0.929	0.064	0.100	-0.766	1.562
Test Marketing<--Commercialization Commitment	0.891	0.006	0.258	1.000	0.883	0.404	1.429	0.220	0.232	-0.072	2.185
Information Dissemination<--Commercialization Commitment	0.950	0.003	0.171	1.000	0.945	0.628	1.305	0.192	0.300	0.226	1.790
Feedback Use<--Commercialization Commitment	0.428	0.003	0.209	1.000	0.423	0.028	0.854	0.147	0.248	-0.407	1.382
Technological Infrastructure<--PPPs	0.199	0.005	0.187	1.000	0.196	-0.161	0.573	0.054	0.551	-0.888	1.094
Economic Support<--PPPs	1.142	0.003	0.213	1.000	1.139	0.728	1.572	0.089	0.349	0.167	2.168
Sectoral Support1<--PPPs	1.349	0.004	0.230	1.000	1.337	0.933	1.834	0.336	0.270	0.504	2.492
Resource Commitment<--Commercialization Commitment	0.132	0.004	0.224	1.000	0.134	-0.319	0.567	-0.052	0.234	-0.932	1.138
Marketing Staff Motivation<--Commercialization Commitment	0.663	0.005	0.195	1.000	0.658	0.295	1.059	0.197	0.440	-0.164	1.678
Accessibility<--Commercialization Commitment	0.836	0.003	0.181	1.000	0.830	0.493	1.212	0.222	0.246	0.089	1.683
Location Awareness<--PPPs	0.035	0.003	0.182	1.000	0.034	-0.318	0.398	0.063	0.183	-0.768	0.846
Public Awareness<--Commercialization Commitment	1.076	0.003	0.192	1.000	1.069	0.719	1.476	0.244	0.209	0.340	1.944
Intercepts											
Economic Support	2.635	0.005	0.191	1.000	2.637	2.253	3.008	-0.048	0.082	1.788	3.372
Sectoral Support1	2.558	0.005	0.238	1.000	2.557	2.088	3.027	-0.005	0.162	1.430	3.637
Technological Infrastructure	3.080	0.003	0.155	1.000	3.079	2.779	3.386	0.037	0.056	2.485	3.749
Accessibility	2.498	0.004	0.172	1.000	2.498	2.158	2.833	-0.029	0.180	1.693	3.220
Location Awareness	2.999	0.002	0.146	1.000	2.999	2.712	3.291	0.005	0.110	2.367	3.581
Resource Commitment	3.275	0.003	0.180	1.000	3.274	2.918	3.629	-0.003	0.162	2.538	4.114
Market Training	3.343	0.004	0.238	1.000	3.343	2.874	3.807	0.002	0.302	2.306	4.764
Test Marketing	3.026	0.004	0.227	1.000	3.026	2.577	3.478	0.029	0.192	1.946	4.003
Information Dissemination	2.752	0.003	0.168	1.000	2.753	2.419	3.079	-0.047	0.160	1.906	3.442
Feedback Use	2.808	0.004	0.175	1.000	2.808	2.461	3.152	-0.021	0.132	2.046	3.547
Marketing Staff Motivation	2.497	0.003	0.171	1.000	2.498	2.162	2.834	-0.028	0.245	1.715	3.186
Public Awareness	2.807	0.004	0.189	1.000	2.805	2.436	3.185	0.022	0.160	2.002	3.614
Covariances											
PPPS<->Commercialization Commitment	0.360	0.003	0.182	1.000	0.371	-0.021	0.684	-0.297	-0.137	-0.400	0.916
Variances											
e2	0.608	0.006	0.295	1.000	0.588	0.084	1.255	0.500	0.975	-0.539	2.449
e3	1.165	0.004	0.251	1.000	1.132	0.776	1.753	0.990	2.013	0.527	2.835
e4	0.796	0.004	0.204	1.000	0.770	0.470	1.269	0.788	1.089	0.160	2.110
e5	1.081	0.006	0.231	1.000	1.051	0.719	1.609	0.859	1.344	0.477	2.455
e7	1.650	0.009	0.353	1.000	1.603	1.102	2.468	0.913	1.542	0.779	3.862
e8	2.626	0.013	0.578	1.000	2.550	1.726	3.973	0.934	1.772	1.018	7.079
e9	1.750	0.008	0.407	1.000	1.698	1.099	2.670	0.723	0.818	0.563	4.232
e10	0.499	0.004	0.168	1.000	0.481	0.224	0.881	0.833	1.797	-0.091	1.664
e11	1.360	0.010	0.321	1.001	1.316	0.891	2.045	1.990	11.882	0.552	4.688
e12	1.032	0.006	0.245	1.000	1.001	0.649	1.601	0.991	2.106	0.400	2.813
e6	0.676	0.005	0.217	1.000	0.653	0.312	1.178	0.688	1.075	-0.079	2.125

The column of means gives the regression weights which are the parameter estimates. Based on the Bayesian Structural Equation Modelling summary above, using PPPs to estimate both sectoral support (mean = 1.349; s.d. = 0.230) and economic support (mean = 1.142; s.d. = 0.213) have the largest weight, thus implying major influence in the model. Using commercialization commitment to estimate public awareness also has a major influence in the model, with a mean of 1.076, s.d. = 0.192. The variables highlighted have insignificant regression weights since their 95% confidence intervals include zero.

On the role played by PPPs to ensure successful R&D–C of research, it is noted that the regression weights are noticeably large, especially the 1.349 value which causes an effect on sectoral support. This implies that there is a big PPPs causal effect, which is confirmed by the qualitative results of the study.

6.9.2 The Initial Model Fit Measures

After determining individual measurements model fit for all variables, some items were ruled out so as to attain better fit to the study's data. This section particularly tests the adequacy of the overall model. The Polygon below measures Posterior Distributions (Sectoral Support, PPPs). The polygon is bell-shaped and the posterior predictive is 0.50 which implies that the model is a correct model.

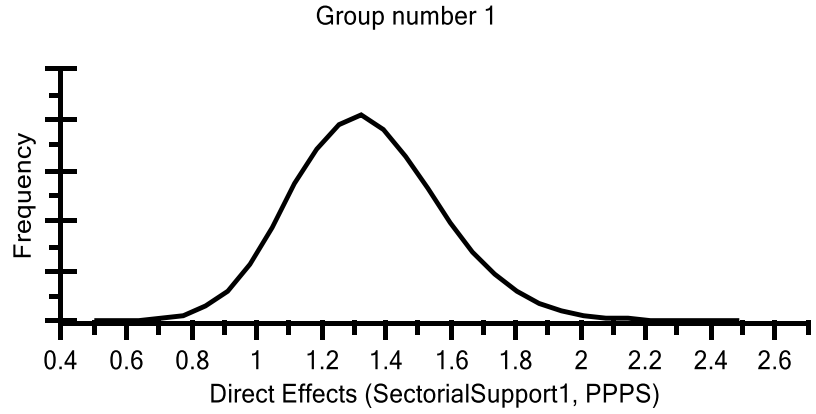

Figure 6.9: Posterior Distributions Polygon (for the initial model)

The posterior distribution of the estimate on Sectoral Support, PPPS is desirably bell shaped. Further, a Trace analysis was run to establish if there was any unusual behavior by the simulation. The trace graph below shows the behavioural outcome.

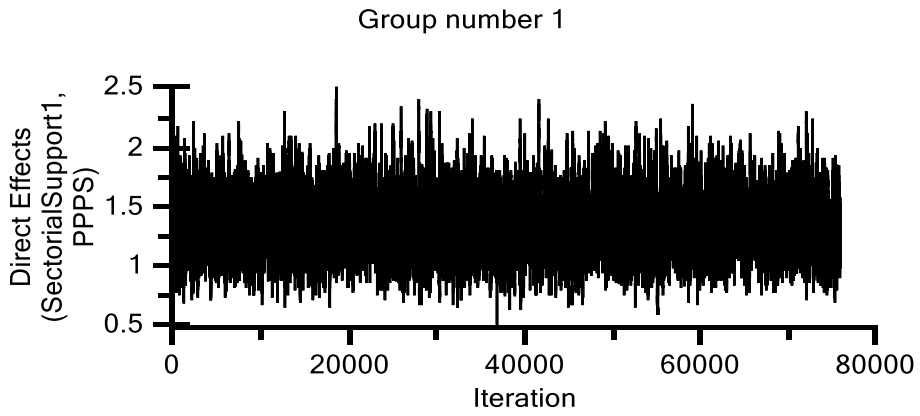

Figure 6.10: The Trace Graph (for the initial model)

The trace left by the simulation of the estimate does not show any unusual behavior. This implies a stable estimate. An autocorrelation graph was created and its tailing off is expected of autocorrelation graphs.

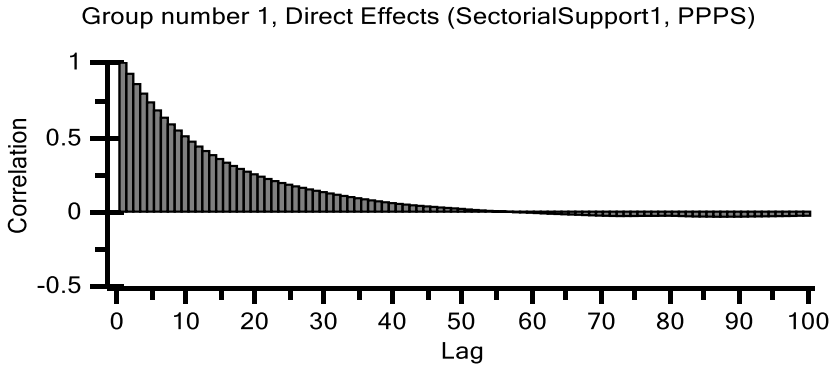

Figure 6.11: The Autocorrelation Graph (for the initial model)

Taking into consideration the issues that emerged from the initial model's statistics, a revised model was deemed fit. Thus, after excluding the variables which had been deemed insignificant during the initial model analysis, the revised model below emerged and was also exposed to posterior distribution, trace and autocorrelation analyses.

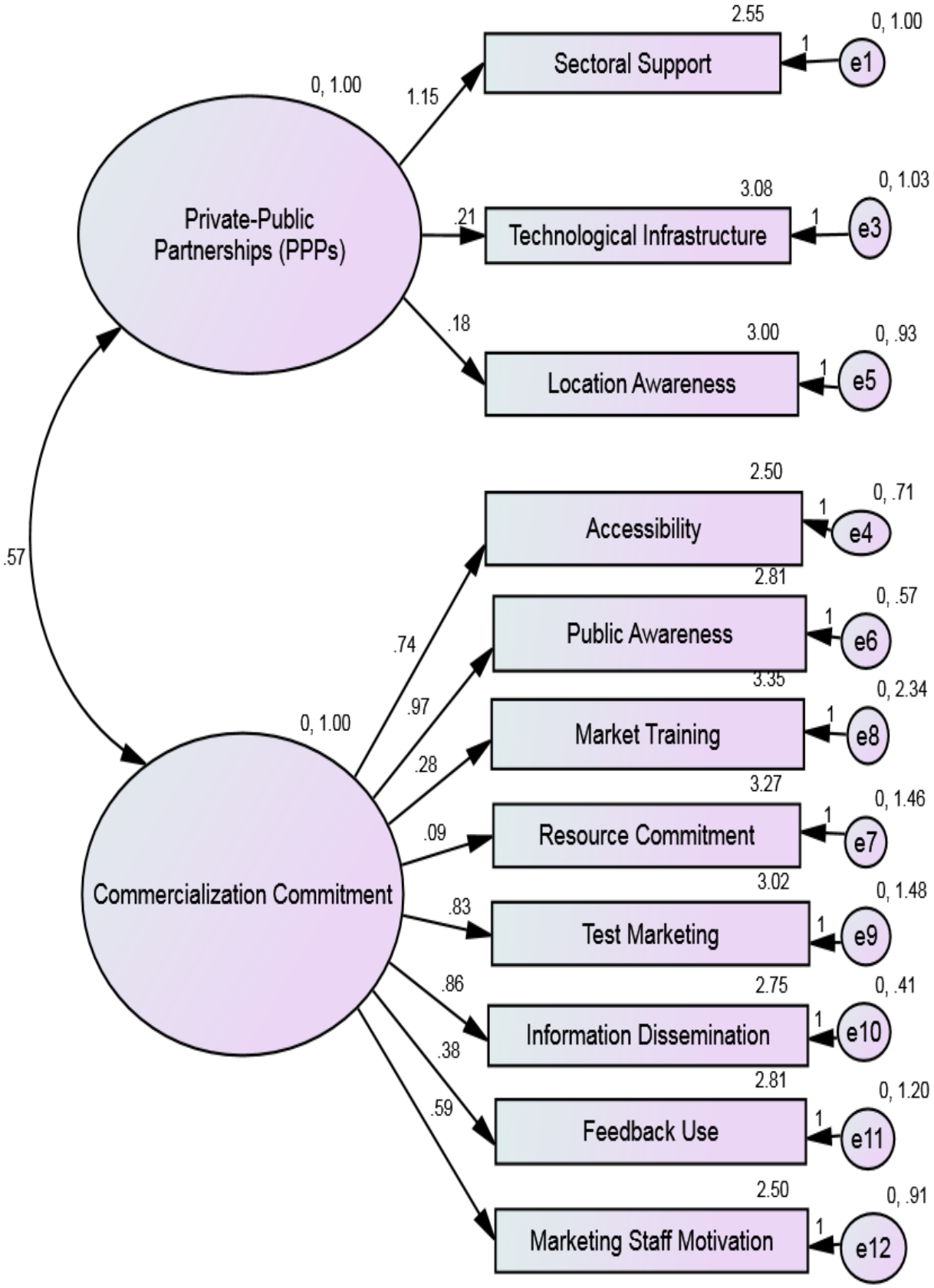

Figure 6.12: The Revised Model (after Removal of Items Excluded from the Initial Model)

Source: ***Developed by the researcher***

The polygon of the parameter when using PPPs to estimate Sectoral support has a mean of about 1.25 and is bell shaped, implying that the posterior distribution of this parameter is normally distributed. The trace graph of the estimation of the parameter when using PPPs to estimate sectoral support did not show any unusual behavior during simulation, which implies that the estimate is a stable one. Autocorrelation was also run and the autocorrelation graph of the parameter when using PPPs to estimate sectoral support is exponentially dying out (as illustrated in the figure below) signaling a good fit of the parameter in the model.

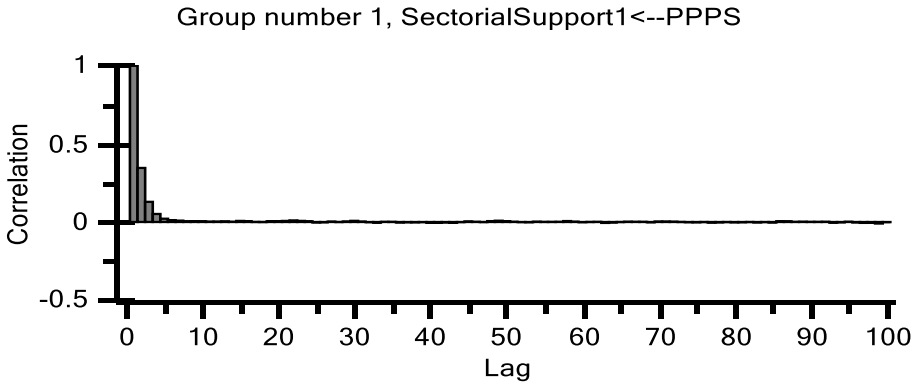

Figure 6.13: The Autocorrelation Graph for the Second Phase of the Model

A Bayesian Structural Equation Modelling was done and the table below summarizes the regression weights.

Table 6.29: Bayesian SEM for the Second Stage of the Model

Regression weights	Mean	S.E.	S.D.	C.S.	Median	95% Lower bound	95% Upper bound	Skewness	Kurtosis	Min	Max
Market Training<--Commercialization Commitment	0.311	0.001	0.286	1.000	0.309	-0.250	0.880	0.038	0.210	-1.178	1.644
Test Marketing<--Commercialization Commitment	0.932	0.001	0.254	1.000	0.924	0.453	1.453	0.192	0.262	-0.214	2.194
Information Dissemination<-- Commercialization Commitment	0.956	0.001	0.169	1.000	0.949	0.643	1.309	0.268	0.319	0.276	1.922
Feedback Use<--Commercialization Commitment	0.432	0.001	0.208	1.000	0.428	0.031	0.852	0.111	0.276	-0.535	1.650
Technological Infrastructure<--PPPs	0.211	0.001	0.210	1.000	0.210	-0.201	0.625	0.013	0.164	-0.933	1.202
Resource Commitment<--Commercialization Commitment	0.098	0.001	0.226	1.000	0.098	-0.349	0.547	0.013	0.239	-1.075	1.236
Marketing Staff Motivation<--Commercialization Commitment	0.656	0.001	0.192	1.000	0.650	0.295	1.051	0.193	0.258	-0.162	1.640
Accessibility<--Commercialization Commitment	0.819	0.001	0.185	1.000	0.813	0.476	1.204	0.249	0.368	-0.141	1.874
Public Awareness<--Commercialization Commitment	1.078	0.001	0.193	1.000	1.069	0.720	1.484	0.271	0.308	0.333	2.119
Sectoral Support1<--PPPs	1.258	0.001	0.242	1.000	1.247	0.808	1.766	0.280	0.438	0.058	2.771
Location Awareness<--PPPs	0.172	0.001	0.205	1.000	0.173	-0.232	0.572	-0.011	0.150	-0.828	1.138
Intercepts											
Sectoral Support	2.546	0.001	0.231	1.000	2.546	2.088	3.002	-0.010	0.189	1.456	3.649
Technological Infrastructure	3.078	0.001	0.154	1.000	3.078	2.773	3.379	-0.011	0.110	2.346	3.787
Accessibility	2.500	0.001	0.171	1.000	2.500	2.163	2.835	-0.006	0.166	1.691	3.307
Location Awareness	3.000	0.001	0.146	1.000	3.000	2.714	3.289	0.013	0.110	2.371	3.743
Resource Commitment	3.269	0.001	0.180	1.000	3.269	2.916	3.625	0.012	0.146	2.413	4.215
Market Training	3.346	0.001	0.233	1.000	3.346	2.883	3.800	-0.020	0.154	2.241	4.452
Test Marketing	3.018	0.001	0.225	1.000	3.018	2.576	3.459	-0.002	0.180	1.937	4.282
Information Dissemination	2.750	0.001	0.166	1.000	2.749	2.422	3.078	0.012	0.156	1.971	3.578
Feedback Use	2.807	0.001	0.175	1.000	2.807	2.461	3.152	-0.007	0.160	1.954	3.681
Marketing Staff Motivation	2.499	0.001	0.169	1.000	2.499	2.165	2.832	0.001	0.151	1.741	3.390
Public Awareness	2.808	0.001	0.189	1.000	2.807	2.436	3.181	0.009	0.150	1.932	3.754
Covariances											
PPPS<->Commercialization Commitment	0.550	0.001	0.188	1.000	0.568	0.134	0.861	-0.544	0.309	-0.425	1.230
Variances											
e3	1.151	0.002	0.250	1.000	1.119	0.754	1.729	0.867	1.527	0.472	3.150
e4	0.817	0.001	0.203	1.000	0.792	0.494	1.284	0.868	1.625	0.121	2.584
e5	1.044	0.001	0.228	1.000	1.015	0.686	1.573	0.864	1.393	0.415	2.726
e7	1.640	0.002	0.350	1.000	1.594	1.090	2.451	0.887	1.510	0.708	4.229
e9	1.681	0.002	0.404	1.000	1.629	1.040	2.620	0.853	1.456	0.395	4.486
e6	0.669	0.001	0.208	1.000	0.647	0.322	1.135	0.674	1.069	-0.260	2.128
e8	2.632	0.003	0.557	1.000	2.560	1.747	3.927	0.818	1.193	1.167	6.786
e10	0.489	0.001	0.158	1.000	0.473	0.223	0.845	0.667	1.059	-0.039	1.471
e11	1.357	0.001	0.299	1.000	1.317	0.893	2.058	0.913	1.596	0.579	3.545
e12	1.031	0.001	0.239	1.000	1.001	0.656	1.583	0.938	2.011	0.427	3.200

Based on this Bayesian Structural Equation Modelling summary, using PPPs to estimate sectoral support has the largest weight (mean = 1.258; s.d. = 0.242) thus implying it has major influence in this second phase of the model. The variables highlighted in green have insignificant regression weights since their 95% confidence intervals include zero. Thus these variables are dropped in the formulation of the final model. The significance of the regression weights above is shown in the table below.

Table 6.30: The Results indicating Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label	S.R.W.E.
Market Training	<---	Commercialization Commitment	.281	.234	1.202	.229	par_1	.181
Test Marketing	<---	Commercialization Commitment	.834	.204	4.084	***	par_2	.566
Information Dissemination	<---	Commercialization Commitment	.859	.135	6.374	***	par_3	.802
Feedback Use	<---	Commercialization Commitment	.384	.171	2.245	.025	par_4	.331
Technological Infrastructure	<---	PPPs	.212	.182	1.167	.243	par_5	.205
Resource Commitment	<---	Commercialization Commitment	.089	.183	.483	.629	par_7	.073
Marketing Staff Motivation	<---	Commercialization Commitment	.586	.157	3.730	***	par_8	.524
Accessibility	<---	Commercialization Commitment	.736	.149	4.924	***	par_9	.658
Public Awareness	<---	Commercialization Commitment	.966	.155	6.233	***	par_10	.788
Sectoral Support	<---	PPPs	1.154	.205	5.642	***	par_11	.756
Location Awareness	<---	PPPs	.181	.172	1.052	.293	par_12	.185

Covariances: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
PPPs	<-->	Commercialization Commitment	.574	.162	3.542	***	par_6

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
PPPs	1.000				
Commercialization Commitment	1.000				
e1	1.000				
e3	1.026	.208	4.936	***	par_24
e4	.708	.163	4.337	***	par_25
e5	.929	.187	4.962	***	par_26
e7	1.458	.288	5.066	***	par_27
e9	1.478	.320	4.625	***	par_28
e6	.568	.165	3.450	***	par_29
e8	2.340	.464	5.039	***	par_30
e10	.411	.124	3.305	***	par_31
e11	1.200	.242	4.956	***	par_32
e12	.907	.192	4.714	***	par_33

The regression weight, 1.154, for PPPs in the prediction of Sectoral Support1 is significantly different from zero at the 0.001 level (two-tailed). Also, the standard errors, the standardized estimates and the

standardized total effects are all below one which is a more desirable scenario. Hence, the model can be used for estimation. However, the regression weights highlighted are not significantly different from zero at the 0.05 level (two-tailed). These have no effect in this model, i.e. they are removed from the final model.

At the 0.05 level of significance, the significant regression weights are for Commercialization Commitment in the prediction of Test Marketing**,** the regression weight for Commercialization Commitment in the prediction of Information Dissemination, the regression weight for Commercialization Commitment in the prediction of Feedback Use, the regression weight for Commercialization Commitment in the prediction of Marketing Staff Motivation, the regression weight for Commercialization Commitment in the prediction of Accessibility, the regression weight for Commercialization Commitment in the prediction of Public Awareness, and the regression weight for PPPs in the prediction of Sectoral Support. Further**,** the covariance between PPPs and Commercialization Commitment is significantly different from zero at the 0.001 level (two-tailed).

The paths "Test Marketing<--Commercialization Commitment", "Information Dissemination<-- Commercialization Commitment", "Accessibility<-- Commercialization Commitment" have significant regression weights of 0.834, 0.859, and 0.736 respectively. Their magnitudes imply that they are greatly influenced by the unobservable variable "Commercialization Commitment" and therefore in turn impact on the commercialization of TIs. Further, the standardized estimates of the regression weights are less than the threshold of one.

The null hypothesis is to be rejected if the p-value (here denoted by P) is less than 0.05. The null hypothesis here says that "the regression weight is not significant" and the alternative is that "the regression weight is significant".

6.9.3 The Final Model

The final model is illustrated in the figure below:

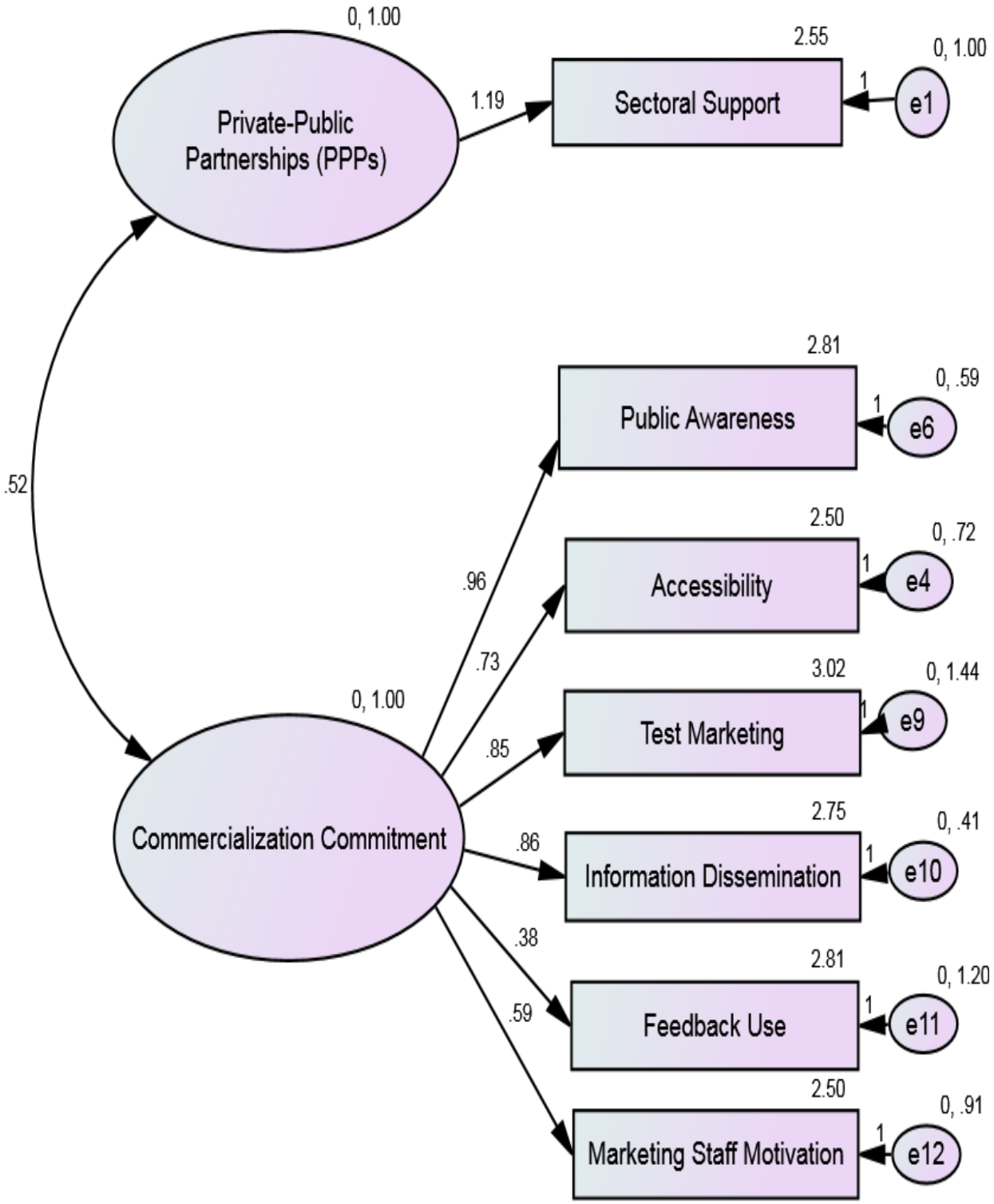

Figure 6.14: The Final Model (Proposed by the researcher)

There are no negative variance error terms implying that there are no problems with the model. This also implies that the error variances are changing in the same direction.

Based on the Bayesian Structural Equation Modelling table 6.31 below, it is quite evident that all the means are significant since their 95% confidence intervals do not include zero. It is still evident that the estimation of sectoral support using PPPs has a major role to play (mean = 1.259; s.d. = 0.225) in as far as R & D-C is concerned. The same can be said of using commercialization commitment to create public awareness where the mean is 1.030, with a standard deviation of 0.183.

Table 6.31: Bayesian SEM for the Final Model

	Mean	S.E.	S.D.	C.S.	Median	95% Lower bound	95% Upper bound	Skewness	Kurtosis	Min	Max
Regression weights											
Feedback Use<--Commercialization Commitment	0.416	0.003	0.198	1.000	0.413	0.032	0.811	0.080	0.176	-0.369	1.431
Marketing Staff Motivation<--Commercialization Commitment	0.633	0.002	0.186	1.000	0.628	0.278	1.013	0.173	0.331	-0.128	1.529
Accessibility<--Commercialization Commitment	0.782	0.002	0.176	1.000	0.777	0.450	1.143	0.164	0.243	0.041	1.721
Sectoral Support1<--PPPS	1.259	0.003	0.225	1.000	1.248	0.847	1.731	0.292	0.235	0.504	2.328
Test Marketing<--Commercialization Commitment	0.926	0.004	0.240	1.000	0.922	0.470	1.416	0.136	0.270	-0.393	2.157
Information Dissemination<--Commercialization Commitment	0.924	0.002	0.160	1.000	0.919	0.626	1.253	0.234	0.317	0.309	1.829
Public Awareness<--Commercialization Commitment	1.030	0.002	0.183	1.000	1.023	0.689	1.408	0.213	0.156	0.337	1.853
Intercepts											
Sectoral Support	2.543	0.003	0.234	1.000	2.542	2.085	3.003	0.008	0.134	1.329	3.677
Accessibility	2.500	0.003	0.168	1.000	2.500	2.174	2.834	0.026	0.018	1.801	3.185
Test Marketing	3.022	0.003	0.221	1.000	3.022	2.589	3.456	0.000	0.124	2.060	3.931
Information Dissemination	2.749	0.002	0.163	1.000	2.748	2.428	3.072	0.004	0.120	2.071	3.412
Feedback Use	2.808	0.002	0.174	1.000	2.807	2.464	3.150	0.022	0.299	1.972	3.710
Marketing Staff Motivation	2.502	0.002	0.166	1.000	2.501	2.177	2.828	-0.019	0.147	1.697	3.181
Public Awareness	2.809	0.003	0.186	1.000	2.809	2.444	3.177	0.017	0.148	1.985	3.689
Covariances											
PPPS<->Commercialization Commitment	0.502	0.003	0.182	1.000	0.518	0.105	0.810	-0.485	0.180	-0.402	1.055
Variances											
e4	0.831	0.003	0.208	1.000	0.805	0.503	1.308	0.933	1.878	0.230	2.397
e9	1.640	0.006	0.393	1.000	1.592	1.014	2.541	0.842	1.438	0.460	4.167
e6	0.689	0.003	0.213	1.000	0.666	0.339	1.184	0.755	1.243	-0.141	1.909
e10	0.488	0.002	0.159	1.000	0.473	0.219	0.843	0.601	0.880	-0.061	1.439
e11	1.348	0.005	0.296	1.000	1.309	0.888	2.033	0.935	1.762	0.581	3.547
e12	1.027	0.004	0.235	1.000	0.998	0.654	1.569	0.834	1.329	0.403	2.675

The polygon of the parameter when using PPPs to estimate sectoral support has a bell shape implying that the posterior distribution of this parameter is normally distributed. The trace graph of the estimation of the parameter when using PPPs to estimate sectoral support did not show any unusual behavior during simulation, which implies that, the estimate is stable. Also the autocorrelation graph of the parameter is exponentially dying out, signaling a good fit of the parameter in this final model.

6.9.4 Summary of the Overall Model Fit

The posterior predictive p is 0.50 implying the model is plausible. Below are various fit indices.

Table 6.32: Overall Model Fit (Summary)

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Initial Model	36	110.941	54	.000	2.054
Saturated model	90	.000	0		
Independence model	12	228.674	78	.000	2.932
Final Model	21	29.052	14	.010	2.075
Saturated model	35	.000	0		
Independence model	7	115.870	28	.000	4.138

The fit measure (CMIN/DF) for the initial model and the final model i.e. 2.054 and 2.075 are comparable. However, the number of estimated parameters in the initial model has to be reduced so as to achieve a parsimonious model (Cheng, 2001). The final model is a parsimonious model with 21 estimated parameters under NPAR. Also, the CMIN/DF index is in the 2 to 3 range implying that not too many variables have been dropped from the model. Therefore, the final model is a good fit and can be used for prediction purposes.

6.10 TESTING OF THE HYPOTHESES

In order to address the research questions raised in section 1.4 of the first chapter of this study, a proposed conceptual framework supported by a set of hypotheses was developed and presented in Chapter 3. This section presents the results of the hypotheses tests. The tests are meant to compare the significant and non-significant relationships in the proposed model through the use of Pearson Chi-Square tests of associations. The hypotheses test results are also evaluated in terms of strength of the relationships using Cramer's Value tests.

Table 6.33: Summary of Hypotheses Results

Hypotheses	p	Remarks
H_1: There is a positive association between the rating of market access and the value placed on the determinant by customers.	***	Supported
H_{2a}: There is a positive association between the extent of failure by government to provide technological infrastructure and commercialization success.	****	Supported
H_{2b}: There is a positive association between successful commercialization and the government giving adequate support for commercialization.	.151	Not Supported
H_3: Successful commercialization of a Technological Innovation (TI) depends on the new product's launch strategies.	.002**	Supported
H_4: Successful acceptance of a TI depends on the proper implementation of market introduction (launch) decisions (i.e. decisions pertaining to launch timing, targeting and positioning, awareness).	.002**	Supported
H_5: Commercialization success depends on the appropriate allocation of PPP roles.	.003**	Supported
H_6: A good acceptance of a new technology depends on understanding market expectations.	.783	Not Supported
H_7: Successful commercialization is most likely to be achieved through customer involvement.	.025*	Supported
H_8: Successful commercialization of a new technology depends on the perceptions consumers or potential consumers hold of it.	***	Supported
H_9: Successful commercialization can be positively influenced by the regulatory environment such as patent protection.	***	Supported

P*** = probability < 0.001; P**= results supported at significance level p < 0.005; P*= results supported at significance level p < 0.05

From the above summary of hypotheses results, seven of the proposed hypotheses are supported while two are rejected. Some of these supported hypotheses confirm the major findings.

6.11 CHAPTER SUMMARY

This chapter has presented the descriptive statistical results of the study, the qualitative aspects of the study together with details of how the final model of the study was prepared, step by step. The chapter reviewed and discussed the fit indices in structural equation modelling using AMOS, the development of the constructs' measurements, assessments and the overall measurement model fit and reports, among other results presented.

In addressing the key research question the final model suggests that there are two important factors in as far as commercialization of TIs is concerned: “PPPs” that influence “Sectoral Support” and “Commercialization Commitment” that influence “Public Awareness”. Thus in a Research Institute, if : [1] a single “PPP” is reached, then “Sectoral Support” increases by a regression weight of 1.259, and
[2] there is a single “Commercialization Commitment”, then public awareness is raised by a weight of 1.030 (Table 6.31). It is therefore necessary to identify determinants which lead to successful commercialization of TIs so that developing countries can create sustainable economies, especially in Zimbabwe. The 0.574 correlation between the “PPPs” and “Commercialization Commitment” is moderately good. The next chapter discusses these findings in view of the extant literature.

CHAPTER 7

DISCUSSION OF RESULTS

7.1 INTRODUCTION

The previous chapter (Chapter 6) presented and analyzed the study's results. This chapter focuses on discussion of the results. This chapter addresses the research questions posed in the introductory chapter (Chapter 1) of the thesis through interpreting the results, and explaining the implications of the study's key findings. Based on the American Psychological Association (APA) guidelines as cited by Ovaska, Morris and Hooper (2014), the discussion explains how the study's findings are related to the existing literature on commercialization of technological innovations. The discussion also takes cognizance of the study's shortcomings i.e. the potential weaknesses of the study in attempting to express the meaning of the study's findings. The study's conceptual framework proposed several hypotheses that were tested and interpreted to draw some conclusions. Grounded on the study's objectives, the discussion is primarily based on these thematic areas: determinants of successful commercialization of technological innovations in Zimbabwe, customer perceptions of technological innovations in Zimbabwe and the role of Private-Public Partnerships (PPPs) in the commercialization of technological innovations.

7.2 DETERMINANTS OF COMMERCIALIZATION OF TIs IN ZIMBABWE

Regarding this objective, the study sought to establish the determinants of successful commercialization of innovations in Zimbabwe's research institutes. By "determinants", the study sought to unearth both the facilitating and the hindering factors of commercialization. However, given that the research problem revolved around the failure by research institutes to commercialize their output, it was deemed imperative to establish the factors hindering the institutes' commercialization efforts. While past studies have focused much on why certain products fail to make it on the market (*e.g.* Geels *et al.*, 2008; Wustenhagen *et al.,* 2008; Christensen, 2000), this study unearthed reasons why certain firms fail to introduce or commercialize innovations on the market.

It emerged from the study that successful commercialization of technological innovations in developing economies such as Zimbabwe is hindered by financial constraints, lack of proper infrastructure, long time lags between new product development and ultimate commercialization, lack of commercialization

interest by researchers', limited capacity for mass production for the total market and patents mal-administration (Table 6.5), with financial constraints topping the list (Table 6.5; Table 6.10). These findings are in support of existing literature. For instance, Pellikka and Lauronen (2007) embed financial constraints and infrastructural barriers in organizational obstacles. Although Pellikka and Lauronen (2007) particularly attribute these organizational obstacles to small firms, this study notes that limited financial resources, poor allocation of scarce resources and infrastructural challenges have handicapped efforts to commercialize technological innovations even in huge research institutes in developing economies such as Zimbabwe.

The study proposed the hypothesis that:

> *H_{2a}: There is a positive association between the extent of hindrance of failure by government to provide technological infrastructure and commercialization success.*

The above prediction that there is an association between the extent of failure by government to provide technological infrastructure and commercialization success (Hypothesis H_{2a}) is supported. This finding is in support of Zaidi and Naeem's (2005) findings who empirically categorized the factors they found to be hindering commercialization of technological innovations in Pakistan into technical factors, organizational, environmental, social, financial and policy related. The duo, however, notes that the differences in categorization may point to the fact that the factors that hinder the commercialization of innovations vary from one country to another. Based on the current study's findings, it is imperative that governments provide the required support in form of infrastructure which should also be well-equipped, appropriately staffed and adequately financed to enhance both development and commercialization of technological innovations.

However, the study rejects the association between successful commercialization and the government giving adequate support for commercialization (Hypothesis H_{2b}). Thus the hypotheses that:

> *There is a positive association between successful commercialization and the government giving adequate support for commercialization* is rejected.

This could be possible in the sense that successful commercialization does not always have to rely on government support. In fact, some institutes which are successfully 'making it on the market' are doing

this quite well without any involvement of the government. Though the government might set what is commonly known as the a Commercialization Fund (CF) to support research institutes' marketing efforts, the rejection of this prediction implies that commercialization success lies more in the organization's efforts rather than dependence on the government. As mentioned in Chapter 3 of this study, the commensuration of the Government of National Unity (GNU) in Zimbabwe (in 2009) saw creation of the Commercialization of Research Department (CRD) which, among other roles, has a role to facilitate policy guidance with respect to innovations, inventions and the commercialization process. This, according to the policy document (2009) was to be enhanced through provision of the Innovation and Commercialization Fund (ICF) and provision of assistance in patenting. Even though some funds have been directed towards assisting some public research institutes in their innovation and commercialization efforts, commercialization failure remains prevalent. Apparently, this study puts forward that much reliance on this fund may result in the "dependence syndrome", a situation where commercialization efforts are fettered due to over-dependence on state funding.

However, the hypothesis that:

> *Successful commercialization can be positively influenced by the regulatory environment such as patent protection (Hypothesis H_9)* is strongly supported.

Patent protection ensures that the inventor is protected against possible imitation of the idea, product or service, thus also protecting the market. However, the study reveals that not much of such protection was provided in Zimbabwe. Market protection or the lack of it has been said to have an impact on the commercialization of technological innovations (Zaidi and Naeem, 2000). The study thus confirms that there is indeed a relationship between the government's provision of a conducive regulatory environment and successful commercialization. These findings validate preceding findings by Weckowska (2010) that government policy and legal framework can go a long way in stimulating commercialization of technological innovations. This implies that governments in developing economies are faced with a huge task of ensuring that the proper and supportive regulatory environment is provided if successful commercialization of the nation's technological innovations is to be enhanced.

Lack of market access or market unavailability to consumers is ranked as the most frequent reason for some customers not having purchased and / or used a new product from any institute within the foregoing twelve to twenty-four months of the study (Table 6.6). In fact, customers and potential customers consider

market access as a very important aspect in their attempts to buy and eventually, adopt a new product. Thus the study supports the hypothesis that:

> *There is a positive association between the rating of market access and the value placed on the determinant by customers (Hypothesis H_1).*

In simpler terms, the study affirms that there is a positive relationship between successful commercialization and market access. Though the "market access" variable has not yet claimed a considerable attention in commercialization literature, the ability for consumers and / or potential consumers to form pre-experience comparison and/or judgment for an unfamiliar innovation can depend on how accessible the new product might be.

Lack of awareness, pricing issues and product-related issues are considered secondary. Import preferences are the least ranked; a clear indication that most Zimbabwean customers are ethnocentric. They are far more comfortable in adopting a 100% Zimbabwean brand compared to imports, because they believe that the local brands are comparatively durable, original and user friendly. These findings validate Apil's (2006) as well as Supphellen and Ritternburg's (2001) observations that when customers are ethnocentric, they negatively evaluate imported products for some reasons. They view buying imports as an inappropriate or rather an "immoral" and an "unpatriotic" practice. They also feel that purchasing foreign products is harmful to the local economy through employment reduction. It thus follows that as long as local innovations in a given economy are positively perceived, imported technology may have no place in such an economy. It also follows that consumers are willing to go by any technological innovation that supports their national identity.

It also emerges from the study that patent protection is yet another determinant of commercialization. This discovery adds value to the existing views that market protection or the lack of it has an impact on the commercialization of technological innovations (Weckowska, 2010; Mowery, 2004; Zaidi & Naeem, 2000). When institutes do not feel that their patents are secure, they hold on to the innovation and the market is starved of the needed innovation.

As anticipated, the study supports the hypothesis that:

Successful commercialization of a Technological Innovation (TI) depends on the new product's launch strategies. (Hypothesis H_3).

This confirmation adds weight to the long found empirical evidence by various launch strategy and tactics proponents such as Hartley (2005), Hultink *et al.* (2000) and Di Benedetto (1999) who substantiate that, despite the new product being functionally and technically sound, successful commercialization can still be flawed due to poor launch strategy. The study's findings, moreover, rally behind the work of Talke and Hultink (2010) who confirm that there is indeed a correlation between new product's launch strategy used and the resultant market performance. This implies that careful attention should be given regarding launching decisions. There is a need to consider the competitiveness of the operating environment and market-related factors such as: who will buy the new product? Where? What is the potential of the target market? What are the market expectations of the new product? Why should they buy from us? What is our Unique Selling Proposition (USP)?

The study's findings suggest that the correct application of a series of launch decisions (such as launch timing, targeting and positioning, awareness) has a statistically significant effect on the acceptance of a new technological innovation. Hence the hypothesis that:

Successful acceptance of a TI depends on the proper implementation of market introduction (launch) decisions (i.e. decisions pertaining launch timing, targeting and positioning, awareness) (Hypothesis H_4) is supported.

The study replicates the findings of Garrido and Polo-Redondo (2005) who postulate that tactical launch decisions have an impact on the market performance of a new product. The findings also confirm the correlation between launch decision choices and market success as later on, confirmed and stipulated in Chiesa and Frattini's (2011) *"anatomy of launch strategy"*. Thus having developed a good product that meets customer satisfaction is not sufficient on its own. There is a need to consider appropriate timing to launch the new product, taking into account seasonal products especially. Thus, appropriate decisions should be made, pertaining to what, why, when, where and how to launch the new product. Due to the involvement of huge commitments of financial, time and material resources, any poor or misapplication of launch decision would result in failure of the new product. Also if the corporate mind-set of the organization is inclined towards appropriate launching of the new product, commercialization failure would be minimized to a larger extent.

Customer involvement also emerges as one of the major determinants of successful commercialization of technological innovations. The proposed final model (Figure 6.14) embeds "feedback use" as one of the key variables in enhancing commercialization commitment. The study thus supports the hypothesis that:

> *"Successful commercialization is most likely to be achieved through customer involvement" (Hypothesis H_{7}).*

Though much commercialization literature has focused much on fellow partner and / or government involvement through Private - Public Partnerships (PPPs), this outcome confirms Greer and Lei's (2012) findings that customer involvement has a positive impact on commercialization success. The finding is also consistent with Im and Workman (Junior)'s (2004) claim that that customer orientation (through customer involvement) is one of the driving forces for new product success. Thus, besides engaging in collaborations with fellow research institutes and the state, the study proves that collaborative innovation with customers enhances the working relationship between the firm and the customer though provision of feedback that should be enacted upon.

This study's results are also in general support of the notion that test marketing, which too emerged as a confirmed predictor variable of commercialization commitment (Figure 6.14), also contributes much in determining the success or failure of a technological innovation. This supports the long standing views of test marketing proponents such as Klompmaker (1976) and Lipstein (1968) who both extensively explored the undisputable role of test marketing in new product development and eventual commercialization. However, test marketing should only be carried out to a level sufficient just to gather any meaningful feedback for improvement. If prolonged, test marketing might result in undesirable effects such as innovation duplication or imitation by competitors, some of whom may even launch the product on full scale ahead of the original inventors. Failure of the new product may also result, particularly if the firm does not respond to consumer feedback through feedback interventions.

Contrary to various past studies (*e.g.* Antioko & Kleijnen, 2010; Nerkar & Shane, 2007; Pollock *et al.*, 2007; Rothamel *et al.*, 2007), the current study does not support the prediction that a good acceptance of a new product depends on understanding market expectations (Hypothesis H_{6}). The study finds that simply understanding market expectations (on its own), as posited by Pellika and Lauronen (2007), does not guarantee successful commercialization of technological innovations. Understanding market expectations

is one aspect, whereas fulfilling them is yet another. This therefore implies that, on the one hand, although customer expectations play a pivotal role in commercializing technological innovations (Antioko & Kleijnen, 2010), it is the establishment of such expectations and the fulfillment thereof that really matters. On the other hand, the decision regarding whether a new product fulfils one's expectations is largely personal and in most cases, it is based on perceptual views. It therefore becomes inevitable that such perceptions may be mixed resulting to non-support of the aforesaid phenomenon.

Similar to Chiesa and Frattini's (2011)'s findings, this study confirms that commercial performance of a new product can be influenced by the perceptions consumers or potential consumers hold of it. The hypothesis that:

> *Successful commercialization of a new technology depends on the perceptions consumers or potential consumers hold of it. (Hypothesis H_8)* is strongly supported.

Chiesa and Frattini (2011) argue that customer acceptance is one of the key commercialization success or failure dimensions that reflect the technological innovations' uptake on the market. The customer acceptance by current and successive generations is, in turn, affected by the customer perceptions of the innovation. Positive perceptions supported by the ability to purchase a product influence the successful commercialization of innovations, and vice versa. However, such perceptions may be difficult to build, especially in view of radical technological innovations. In such cases, the customer may have to base their judgment on any past experiences with the organization (if any), if not the perceived value of the technological innovation.

7.3 CUSTOMER PERCEPTIONS OF ZIMBABWE'S INNOVATIONS

Regarding this theme, the objective of the study was to determine customer perceptions on the state of innovations commercialization in Zimbabwe vis-à-vis their innovation expectations. Perceptions regarding several variables related to Zimbabwean technological issues were gathered and mapped – i.e. innovation uniqueness, quality, pricing issues, accessibility, local-import preferences, product promotional issues, market support and other related variables. In the current study, it is established that Zimbabwean customers generally perceive their local innovations to be unique as evidenced by a *mean* of 4.*54 (s.d. = 1.171)* (Table 6.14). Zimbabweans also perceive their local products to be of high quality, original, safe and user-friendly. Because of this, Zimbabwean customers generally

prefer their own local technological innovations to imports. The study thus confirms the existing empirical evidence of the "Country of Origin" (COO) concept and its effects, in line with Lee *et al.* (2013), Klein (2002) and Nagashima (1970). Various other studies have been carried out in different countries to confirm this, for instance in UK (Realini *et al.*, 2013); USA (Lim *et al.*, 2013); Korea (Hoon & Katherine, 2013), China (Maruyama & Wu, 2014) and South Africa (Kaynak, Kucukemiroglu & Hyder, 2000). This is largely an issue to do with the level of confidence held by citizens of the locally produced products. Once perceived to be of good quality, any rational consumer is likely to promote their local manufacturers through buying local innovations.

This has implications on the new product Country of Origin (COO) labeling, i.e. the new technological innovation's label has to include a *"Made in Zimbabwe"*, *"Proudly Zimbabwean"* or *"100% Zimbabwean"* encryption to instill and enhance the consumer confidence in the new product. However, when the general quality perceptions are negative, consumers will "search" for their COO *zones of comfort* from various foreign countries, hence local consumers cease to be ethnocentric.

Although Zimbabwean customers perceive their local innovations to be unique and of high quality, accessibility *(mean = 2.22; s.d. = 1.484)*, market support and marketing communications issues are still perceived to be a challenge. It emerged that customers do not agree with the notion that Zimbabwe's innovations are accessible and that they are well promoted. The study's proposed final model also features "market accessibility" and "information dissemination" as some of the pivotal determinants of commercialization commitment (Figure 6.14).

Preceding studies postulate that consumers' perceptions of price, quality, and value are the "pivotal" determinants of buyer shopping behavior and product choice (*e.g.* Zeithaml, 1988; Jacoby & Olson 1985; Doyle 1984). While these are indeed key perceptual issues, this study rather considers accessibility and information dissemination to be pivotal, particularly in the commercialization of new technological innovations. This variance in the findings could be due to the fact that these preceding studies were primarily focusing on existing products while the current study focuses on new products. Customers may perceive a product to be of high quality, "fairly" priced, original and of high value but if the product is not accessible and is not well-promoted, then commercialization failure is inevitable.

It also emerged from the study that mixed perceptions surround the pricing of Zimbabwe's technological innovations. Respondents remained neutral regarding the notion that Zimbabwe's innovations are

affordable *(mean = 3.03; s.d. = 1.134)*. This is expected from the study given the widely divergent views on prices in most developing economies such as Zimbabwe. Akin to Xia, Monroe and Cox (2004) and Rao and Monroe's (1989) integrative views on price, the current study supports the view that, for pricing perceptions to be one-side orientated rather than mixed, price has to be integrated to other predictor variables such as brand name, store name and buyer's perceptions of quality. To consider pricing perceptions on their own could be suicidal in the sense that price might have different meanings to different classes of customers. What is considered "cheap" or "affordable" by one group of customers or potential customers might not necessarily be the same with the other group.

The fact that the study treated the whole sample of the study as one group might have contributed to these mixed perceptions. Future studies focusing on perceptions could attempt to use multi-samples. Including multiple customer groups or classes could have diversified the customer classes and ethnicities represented in the study's sample. The current study would also have benefited from a question regarding the respondent's social class.

7.4 THE ROLE OF PRIVATE-PUBLIC PARTNERSHIPS (PPPs) IN COMMERCIALIZATION

The other objective of the study was to establish the role of Private - Public Partnerships (PPPs) in the commercialization of technological innovations in developing economies such as Zimbabwe. Before establishing the specific roles that PPPs play in the commercialization of technological innovations, it was deemed necessary to establish if the allocation of PPP roles really mattered in commercialization, thus the following hypothesis was proposed:

H_5: Commercialization success depends on the appropriate allocation of PPP roles.

As anticipated, the prediction that commercialization success depends on the appropriate allocation of PPP roles (Hypothesis H_5) is supported. This finding adds value to the existing literature on PPPs whose main focus has been on the role of PPPs in national service delivery (*e.g.* Witters *et al.*, 2012; Hellowell *et al*., 2008) yet very little has been done focusing on network relations in the commercialization of technological innovations (Aarikka-Stenroos & Sandberg, 2012). Thus the study confirms that there is a correlation between PPPs and successful commercialization, with particular emphasis on the partners' ability to play their appropriate roles. It emerges from the study's results that sectoral support is necessary

for any meaningful commercialization commitment. A private research institute will require support from the public sector and vice versa, hence benefiting from each of the individual firms' areas of strength. This implies that in a PPP setting, certain roles have to be shared amongst the partners - but which roles are these?

It emerged from the study that indeed PPPs play a critical role in the commercialization of technological innovations including: risk sharing; product knowledge sharing and information dissemination; PPPs improve economic competitiveness; PPPs enhance demand-driven research; they ensure avoidance of technology duplication; they enhance capacity building; PPPs as a policy too; faster and improved project delivery; the facilitate the use of private sector expertise; PPPs drive innovation and enhance economy sustainability among many other roles that emerged (Table 6.21).

Regarding risk sharing, the concept of "sharing innovation development and management-related risk" as the major "benefit" mainly obtained through PPPs emerged. Institutes who engage in PPPs see the partnerships as vehicles through which costs, responsibilities and innovation risks of possible new product failure can be shared together with the benefits that come through the alliances. Preceding studies such as Mohr *et al.* (2005) reiterate that risks are inevitable in the development and commercialization of TIs. Under a *legal* construction of PPPs (Witters *et al.*, 2012), the partners share risk, reward and responsibility for a shared investment (Akkawi, 2010). This therefore implies that PPPs are not merely special vehicle for projects funding - they call for full dedication from all parties involved to ensure minimum risks prevail.

Product knowledge sharing and information dissemination emerged as the other role played by PPPs in commercialization of technological innovations. Echoes such as the "joy of seeing an innovation sailing through the market" and the need to "get the technological innovation out of the research institute" prevailed in this study. This implies that the organization of PPPs is viewed as an imperative move for enhancing Research & Development – and Commercialization (R & D – C) of technological innovations. Commercialization is especially enhanced through increased visibility of the new product. The PPP thus becomes a special vehicle for sharing and disseminating information on the new products launched. The PPP also becomes an important vehicle for disseminating the new technology itself.

In a related development, it also emerged that research institutes naturally perceive alliances that include international partners as more "lucrative" and "ideal" in enhancing international exposure and

international recognition of Zimbabwe's innovations. These have reportedly been facilitated through exchange programmes, international exhibitions, international conference presentations and affiliation to relevant international professional bodies that govern the institutes' business conduct. However, these international collaborations are engaged with at the expense of the local PPPs, which are described by most key informants of the study as "weak" and "not reaping much of the expected outcomes". This finding confirms Cavusgil's (1998) proposition that firms will naturally go for international partnering even in cases where they can evidently get better deals locally. Through such international partnering, the firm becomes competitive on the global market place as "global markets become more attractive and domestic markets remain stagnant" (Cavusgil, 1998: 92), the firm secures some complementary assets required to commercialize its technological innovations (Greis, Dibner & Bean, 1995) and it also helps in averting and reducing risk (Burns, Warren & Oliveira, 2014). Camuffoo and Volpato (2002) weigh in by describing alliances as "capital efficient", and that they ensure effective talent management while overcoming the trauma that may emerge in the market due to the cultural and marketplace dynamics created by the new offering.

It also emerged that PPPs improve the economic competitiveness of a nation. Interviewees strongly believe that such an improvement can be achieved through PPPs' ability to modernize national infrastructure. This finding conforms Witters *et al.*'s (2012) and Crozier's (2010) findings that PPPs can improve urban living through collaborations that combine innovative efforts from the private sector, forward-thinking policies from governments, and support from nonprofit organizations. This implies that when a country engages in these alliances, in most cases the PPP erects structures for production, sales and marketing and administration. Employment is created, living standards are improved; peoples' tastes improve as they move along with technology. This means that new technologies' market uptake improves as well. The study thus finds that there is a positive relationship between economic competitiveness and the uptake of the research institutes' technologies. The relationship is, however, enhanced through infrastructural development which, in turn, is enhanced through PPPs.

When properly formulated and effectively run, PPPs facilitate the introduction of demand-driven technologies, "with a ready market". A properly coordinated PPP taps into the funding provided for by the state whilst utilizing the market expertise availed by the private sector. In this way 'academic research' with no 'takers' is avoided. PPPs ensure the use of the private sector expertise in terms of technology, marketing, management, and customer service for implementation of the public sector objectives (Brinkerhoff & Brinkerhoff, 2004; Sedjari, 2004). Thus for the PPPs to be "properly

organized" and "effectively run", there is indeed need for adequate funding, ensuring national political stability, proper communications between parties to the alliance, creation of platforms where issues can be raised and discussed (stakeholder consultation forums) as well as the need for appointing a "referee" to coordinate the PPP activities. While literature emphasizes other key success factors such as appropriate risk allocation and risk sharing (Qiao *et al*., 2001; Grant, 1996); commitment (Kanter, 1999) and other factors, this study emphasizes the need for a PPP "referee". This is probably as a result of continued failure of some PPPs in developing economies due to lack of coordination. Thus this "referee" could be in the form of a PPP coordinating committee with representatives from the Funders or Donors of the alliance, supervisory body, executing agent, and from the implementing agent - the research institute.

It also emerged from the study's interviews that properly run PPPs help in avoiding unnecessary duplication of technology amongst both public and public research institutes, thus ensuring efficient allocation of scarce resources. Not only will technological innovation duplication be avoided but the speed will also be enhanced. This reduces the time lag between new product development and full scale commercialization of the new product. By using private sector finance where it is considered appropriate, PPP's can promote the accelerated delivery of the public capital programme by enabling more infrastructure projects to be carried out within a defined period of time (Hellowell *et al*., 2008). Thus speedy R & D and commercialization can be enhanced through PPPs. Combined efforts from the PPP players could result in a unique technological innovation, in a better form, compared to two "otherwise similar technologies emanating from the research institutes as separate players". These views are based on the notion that "two is better than one" leading to the equation that *"1+1=3"* in PPPs.

While increased private sector partaking, especially in the provision of public services, has the potential to deliver benefits, Hellowell *et al*. (2008) give a precautionary note that PPP's are not a universal panacea nor the only means to deliver quality public services on a value for money basis. Based on this limitation, the current study maintains that a proper PPP for the purposes of technological innovation commercialization should be one in which the public sector (through the government and donor funding) concentrate on funding the R & D – and Commercialization, while the private sector focuses on providing marketing analytics skills to enhance the new product commercialization.

PPPs are also seen to be special enhancement tools for capacity building. The study's respondents are in support of the view that PPPs facilitate capacity building projects for their respective institutes. This capacity building is seen to be very prevalent in the areas of product standardization, certification, verification and sustainability. This implies that the weaknesses of one partner in the PPP may be

overcome by the other partner's strengths as the PPP players complement each other in terms of skills – from production right through to post-sales skills. This complementary effect raised by the current study supports the need for "social support" as one of the critical success factors contributed by Frilet (1997).
The role is further enhanced through the use of informal relationships to support the PPP. According to Martinelli *et al.* (2008), in support of Landry *et al.*'s (2002) findings, informal networks often facilitate more formal relationships that facilitate spinoff and licensing arrangements with established firms.

PPPs also emerged as critical innovation policy tools. Built on the belief that private players are superior to the public sector in efficient resource allocation, the study's findings align with Smits and Kuhlmann (2004) who claim that PPPs, as a policy tool, enhance and / or reinforce the quality of an economy's innovation systems through improving the interfaces that exist between the nation's technological innovations' research systems and industry as a whole. Even though governments reportedly have some PPP championing behavior (Caerteling *et al.,* 2013), this trend (established by the study) has obvious implications for policy makers. It implies that PPPs allow the quality and cost of new technologies to be benchmarked against the prevailing standards on the local, regional and on international markets. It emerged from the study that combined resources and skills necessitate such benchmarking, which in turn, helps in ensuring effectiveness and efficiency in all processes involving the technological innovation development, right through to commercialization.

7.5 CHAPTER SUMMARY

The chapter discussed the study's findings in relation to the existing literature on commercialization of technological innovations. Anchored on the objectives of the study and the relevant hypotheses proposed, the chapter has discussed results relating to the determinants of successful commercialization of technological innovations in Zimbabwe, customer perceptions of technological innovations in Zimbabwe as well as the role of Private-Public Partnerships (PPPs) in the commercialization of technological innovations. In the following chapter (Chapter 8), major findings are emphasized upon which conclusions are drawn, the implications of the study are brought to light, while recommendations and suggestions for further research are proposed based on the study's conclusions and limitations.

CHAPTER 8

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

8.1 INTRODUCTION

This chapter gives an overview of the major issues discussed in the previous chapters of the thesis. Major findings are emphasized upon which conclusions are drawn from the study. The chapter also brings the implications of the study to light, while recommendations and suggestions for further research are proposed based on the study's conclusions and limitations. The results of the study indeed answer the set research questions. The survey, through the analysis of the collected data and presentation of results, discloses the determinants of successful commercialization of technological innovations in developing economies such as Zimbabwe, establishes the customer perceptions of technological innovations in Zimbabwe and the role of Private-Public Partnerships (PPPs) in the commercialization of technological innovations. The survey also develops a roadmap as an intervention tool in policy-making as a way forward based on the research findings.

8.2 SUMMARY OF THE THESIS' REPORT

This study was aimed at establishing the determinants of successful commercialization of technological innovations in Zimbabwe's research institutes. This write-up is made up of eight chapters. In the first chapter of this thesis, the researcher laid down an overview of the research problem and its setting by outlining the background to the study, the problem statement, research objectives and stating how the thesis was organized. Despite the numerous and laudable achievements made in the area of research in Zimbabwe, it was noted that the country was yet to enjoy the benefits of seeing those research outcomes being commercialized. It was thus put forward that, the identification of determinants which can lead to successful commercialization of technological innovations in developing countries could result in the creation of sustainable economies in most third world African countries such as Zimbabwe. The chapter set the study's four-fold objectives as follows: to establish the determinants of successful commercialization of innovations in Zimbabwe's research institutes; to determine customer perceptions on the state of innovations commercialization in Zimbabwe vis-à-vis their innovation expectations; To establish the role

of Private-Public Partnerships (PPPs) in the commercialization of technological innovations; and to develop a roadmap as an intervention tool in policy-making as a way forward based on the research findings. The study's research questions were directly deduced from these research objectives.

In the second chapter the researcher presented a comprehensive and systematic review of prior literature on the commercialization of innovations. In this chapter, the researcher operationalized "successful commercialization" and reviewed literature on its determinants (facilitators and inhibitors of successful commercialization), consumer perceptions of new products and the role of PPPs in the commercialization of technological innovations. Gaps in prior literature were established and the current research endeavored to fill in such gaps, while adding value to the Body of Knowledge.

Rooted in the works of several scholarly articles, the literature review established that most of the determinant factors for successful commercialization are double sided, i.e. while the presence of one factor could enhance commercialization, the unavailability of the same factor could hinder commercialization. Literature summarized and categorized the determinants of successful commercialization into technical, organizational, environmental, social, financial and policy related factors. The literature review chapter also noted that varying perceptual consumer behaviours have either positive or negative impact on the adoption of new technologies depending on the type of word-of-mouth information that spreads across the market. Regarding PPPs, the reviewed literature revealed that collaborative R & D and commercialization activities among industries in most developing economies are still low, although there is great potential for improvement. It was clear from the review that most literature dwells on PPPs in national service delivery and very little work has been done focusing on TIs' commercialization by PPPs. Nevertheless, PPPs have a role to play in the commercialization of technological innovations and this revolves around risk sharing, economy sustainability, innovation driving, expertise sharing and improved project delivery, among other factors.

In Chapter Three the researcher probed into, and synthesized the various theories underpinning the commercialization phenomenon, inclusive of the widely pronounced *Stage Gate Model*. Through a systematic review of the existing literature and empirical studies, the researcher developed a theoretical framework / model, and proposed hypotheses meant to test the workability of the model. Borrowing from other past model contributions, inclusive of the Dimensional Model of Commercializing Innovations

(Chiesa and Frattini, 2011); the *Functional Model* (Industry Canada, 2006); the *Carnegie Mellon Innovation Transfer Process Model* (The Interactive Model) (Carnegie Mellon University, 2002); the *Multi-Faceted Technology Commercialization Process* **(**Jolly, 1997); the *Stage Gate Model* (Cooper, 1996); the *Goldsmith Commercialization Model* (Goldsmith, 1995); the *Traditional Sequential New Product Development (NPD) Model* (Cooper & Kleinschmidt, 1995); the *University Technology Commercialization Model* (Lee & Gaertner, 1994), a conceptual framework for commercializing technological innovations in developing economies was developed. The model has two dominant theoretical concepts, successful commercialization determinants (the predictor variables) and PPPs (mediating variable) around which various hypotheses were developed to address the research question.

In Chapter Four, the researcher reviewed the Research and Commercialization Policy in Zimbabwe. In this chapter the researcher explored the role of the government in commercializing technological innovations and traced Zimbabwe's success as far as technological innovation (TI) development and commercialization policy is concerned. This chapter explored the current state of the policies, institutions and the Zimbabwean government's efforts in commercialization and unearthed the commercialization challenges as well as the gaps in the current policy. Some of the gaps established in the current policy include the absence of an effective integrated national system of innovation, absence of incentives for R & D, limited and unpredictable financing arrangements, and unclear institutional arrangements. It also became clear from the policy review that researchers and research institutes often focus on academic excellence and not commercialization of their R & D outputs for economic development.

In Chapter Five the researcher presented an account of how the research was carried out. The researcher also addressed the issues of data validity, reliability, replicability and generalizability of the study's results. In tackling the objectives of the study, the researcher utilized mixed research methodologies based on the integrative nature of the research design and philosophy. Two pre-coded questionnaires and interviews were primarily used to collect data for the study. The researcher conducted Cronbach's Alpha (α) reliability tests as part of determining the reliability of the study's results. Cronbach's Alpha internal testing was also conducted to establish internal consistency of the instruments in addressing the research objectives. The results of the tests (0.9288) showed that there was a very high level of internal reliability and consistency, especially among the items that employed the Likert scale. This methodology chapter also described how research ethics were accounted for to ensure that the study was carried out ethically. Chief amongst these were the facts that permission to conduct the study was sought from the research institutes involved and the study encompassed only those institutes whose permission to engage them in

the study was granted; Ethical Clearance (EC) was sought and obtained (E.C. Number ***HSS/0457/013D***) from UKZN, through the Humanities and Social Sciences Research Ethics Committee; prior respondents' consent was sought before engaging each respondent; and the respondents' privacy, confidentiality and anonymity were assured regarding the respondents' identity and responses, and this was honoured (see Appendix 1 for Ethical Clearance Certificate). The collected data were analysed using the Statistical Package for Social Sciences (SPSS) (version 22.0), enhanced with AMOS and Text Analytics, for modelling and qualitative data analysis, respectively.

In Chapter Six the researcher reported the results of the study, presented data, explained and analyzed the main research findings. Given that mixed research methodology was utilized, both quantitative and qualitative data were presented and analyzed. The chapter thematically presented the descriptive and inferential statistical results of the study, as well as the qualitative aspects of the study. Central to the data presentation and analysis chapter, is the iterative process of how the final proposed model of the determinants of commercializing innovations was prepared and statistically tested, step by step. The chapter reviewed and discussed the fit indices in structural equation modelling using AMOS, the development of the constructs' measurements and assessments as well as depicting the overall measurement model fit.

In the seventh chapter the researcher discussed the results presented in the chapter six in relation to existing theories and knowledge. Guided by the study's objectives, the chapter thematically discussed the determinants of successful commercialization of technological innovations in Zimbabwe, customer perceptions of technological innovations in Zimbabwe and the role of Private-Public Partnerships (PPPs) in the commercialization of technological innovations. In support of various preceding studies, the current study supported the hypotheses that successful commercialization of technological innovations is influenced by market access, government's provision of technological infrastructure, perceptions consumers or potential consumers hold of the new product, customer involvement, appropriate allocation of Private-Public Partnership (PPP) roles, the approaches (launch strategies) used to commercialize it and bring it to the market, and the correct application of a series of launch decisions (launch timing, targeting and positioning, awareness). However, the study refuted the assertion that good acceptance of a new product depends on meeting market expectations, and also disproved an association between successful commercialization and the government giving adequate support for commercialization.

In this eighth chapter the researcher gives an overview of this thesis, by demonstrating the extent to which the study's empirical results address the research questions, thus achieving the objectives of the study. The researcher emphasizes major findings upon which conclusions are drawn, while recommendations and suggestions for further research are proposed based on the study's conclusions and methodological limitations.

8.3 CONCLUSIONS

The study was aimed at addressing four research questions posed in the introductory chapter (Chapter One), i.e. what are the determinants of successful commercialization of innovations in Zimbabwe's research institutes? How do customers perceive Zimbabwe's local innovations vis-à-vis their innovation expectations? What role do PPPs play in the commercialization of technological innovations in Zimbabwe? Based on the research findings, what could be done to improve the commercialization of technological innovations in Zimbabwe's research institutes? These questions, formulated based on the research objectives, were addressed by the study.

- The study established that financial constraints, poor allocation of scarce resources, lack of proper commercialization infrastructure, long time lags between new product development and ultimate commercialization, lack of commercialization interest by researchers, limited capacity for mass production for the total market and patents mal-administration hinder successful commercialization of technological innovations in Zimbabwe. The study confirmed that there is an association between the extent of hindrance of failure by government to provide technological infrastructure and commercialization success. However, the study rejected an association between successful commercialization and the government giving adequate support for implying that research institutes' successful commercialization does not always have to rely on government support.
    - From a customer perspective, successful commercialization of technological innovations is determined by market access, customer involvement (through the use of customer feedback), test marketing as well as the launch strategies used for the new product. Lack of market access or market unavailability to consumers was ranked as the most frequent reason for some customers not having purchased and / or used a new product from any institute within the foregoing twelve to twenty-four months of the study. There is a positive relationship between successful commercialization and market access.

- Customers and potential customers consider market access as a very important aspect in their attempts to buy and eventually, adopt a new product. The commercial performance of a new product can be influenced by the approaches (launch strategies) used to commercialize it and bring it to the market, hence there is also a positive relationship between successful commercialization and the launch strategies used. However, though necessary, lack of awareness, pricing issues and product-related issues are considered secondary determinants of successful commercialization.
- There is also a positive relationship between successful commercialization of technological innovations and the correct application of a series of launch decisions (such as launch timing, targeting and positioning, awareness).
- Contrary to past studies, there is no relationship between successful commercialization and understanding market expectations. Simply understanding market expectations (on their own), does not guarantee successful commercialization of technological innovations – it is rather the enactment of the customer expectations that may guarantee successful commercialization.
- The commercial performance of a technological innovation can also be influenced by the perceptions consumers or potential consumers hold of it.

➲ Zimbabwean customers generally perceive their local technological innovations to be unique, to be of high quality, original, safe and user-friendly. Because of this, Zimbabwean customers generally prefer their own local technological innovations to imports, i.e. Zimbabwean customers are ethnocentric. They are more comfortable in adopting a 100% Zimbabwean technological innovation compared to imported brands, because they believe that the local brands are comparatively durable, original and user friendly.

- Although Zimbabwean customers have positive perceptions regarding their technological innovations, market support and marketing communications issues regarding the new products are still perceived to be a challenge. Customers do not agree with the notion that Zimbabwe's innovations are accessible and that they are well promoted.
- Consumers have mixed perceptions regarding the pricing of Zimbabwe's technological innovations.

➲ Just like in service delivery where they seem to dominate, Private-Public Partnerships (PPPs) play a critical role in the commercialization of technological innovations including: risk sharing,

product knowledge sharing and information dissemination, PPPs improve economic competitiveness; PPPs enhance driven research, they help in avoiding unnecessary technology duplication; they enhance capacity building; PPPs are valuable as a policy tool; result in faster and improved project delivery; they facilitate the use of private sector expertise, they drive innovation and enhance economy sustainability. However, it emerged that commercialization success depends on the appropriate allocation of PPP roles.

8.4 CONTRIBUTION TO THE BODY OF KNOWLEDGE

Although some studies have been carried out elsewhere, the researcher is very confident that research institutes active in a developing economy such as Zimbabwe have been waiting for research similar to this, as a lasting solution to their dilemma of having to create, invent ideas, concepts, prototypes and products without enjoying the fruits thereof. In fact, much previous work has concentrated mainly on commercialization issues in developed and emerging economies (*e.g.* Antioco & Kleijnen, 2010; Corkindale, 2008; Pellikka & Lauronen, 2007; Pellikka & Virtanen, 2003; Andrew & Sirkin, 2003; Jolly, 1997), with a few in small firms (*e.g.* Pellikka & Malinen, 2014) whereas only a few studies have focused on developing economies (*e.g.* Chandran, 2010). The few studies that have been carried out focus primarily on the barriers of commercialization. Much work sought to understand the factors that explain the challenges faced by research institutes in developing economies in commercializing their technological innovations; and literature on PPPs in developing economies seemed to be lagging behind. The literature has been primarily limited with regards to 'how', i.e. defining commercialization success, and the factors that influence (i.e. facilitators and hindrances) that success (Phan and Siegel, 2006; Shane, 2004). The current study thus incorporated perceptual issues together with the role played by PPPs, over and above establishing the determinants of successful commercialization.

Of the determinants of successful commercialization that emerged from the study, most of the determinants confirmed past studies' findings. However, it seemed the "market access" variable has not yet claimed a considerable attention in commercialization literature. Thus this study weighs in through establishing that the ability for consumers and / or potential consumers to form pre-experience comparison and / or judgment for an unfamiliar innovation can depend on how accessible the new product might be. Customer involvement also emerged as one of the major determinants of successful commercialization of technological innovations. Though much literature has focused much on fellow partner and / or government involvement through Private - Public Partnerships (PPPs), this emerging theme confirms one of the few recorded findings (Greer & Lei, 2012) that customer involvement has a

positive impact on commercialization success. Thus the study echoes the importance of having Research Institute-Customer Partnerships over and above PPPs.

The study's findings add value to the existing literature on PPPs whose main focus has been on the role of PPPs in national service delivery (Witters *et al*., 2012; Caerteling *et al.,* 2008; Hellowell *et al*., 2008) yet very little has been done focusing on network relations in the commercialization of technological innovations (Aarikka-Stenroos & Sandberg, 2012; Chandran *et al.,* 2008) predominantly in developing economies. The theory of Public-Private-Partnerships (PPPs) and their increasing applicability, especially in the provision of public facilities and services has commanded some research interest worldwide. However, few attempts have been made to unlock the value in the PPP's capability in enhancing commercialization of technological innovations, worse still from a developing economy's perspective. This study unlocks the value through exploring the role that PPPs play, particularly in the commercialization of technological innovations. However, it is made clear that commercialization success largely depends upon the appropriate allocation of the PPP roles. Perhaps the major contribution made by the study lies in the final model presented in Figure 8.1. below:

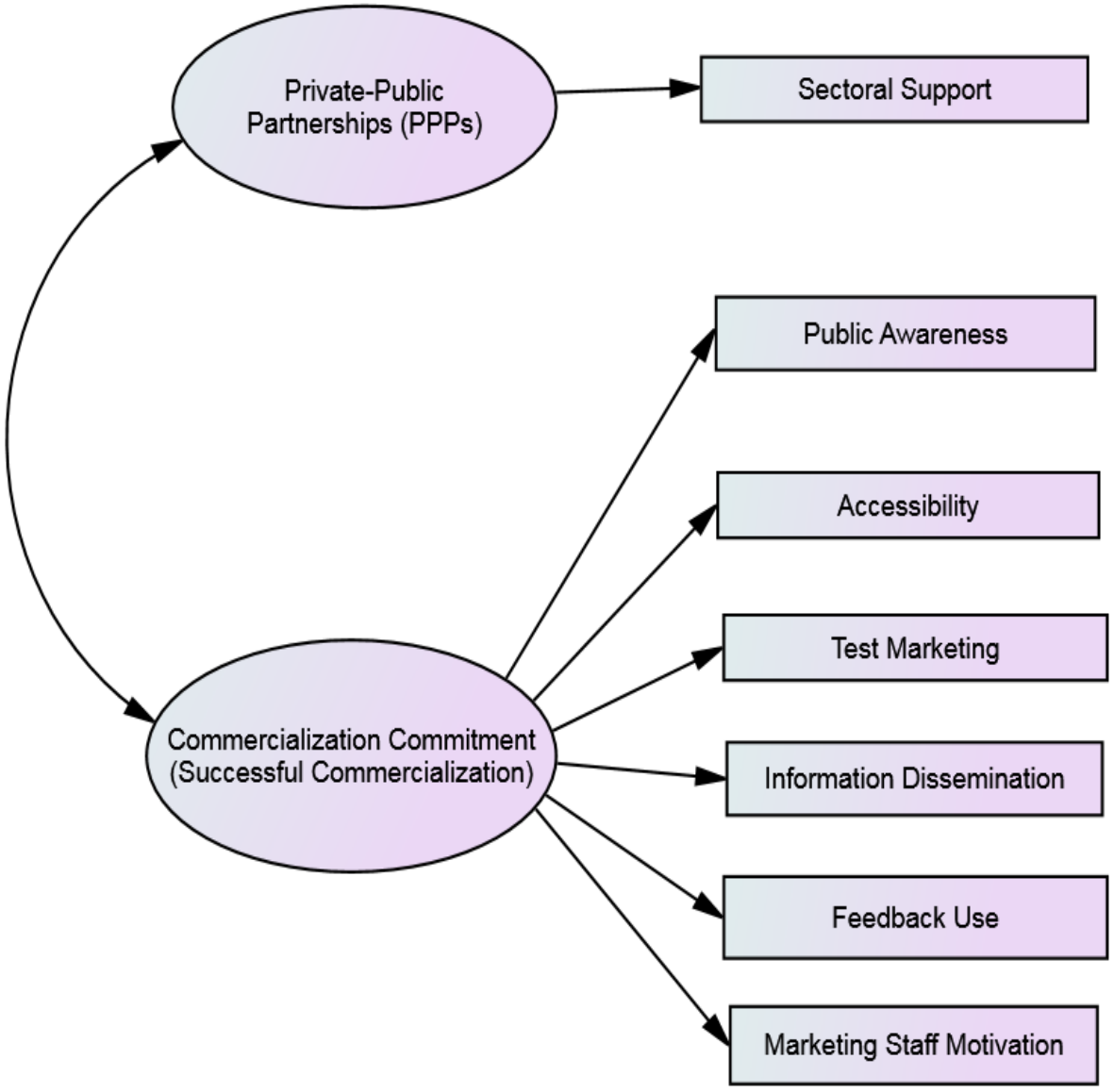

Figure 8.1: Model for Successful Commercialization of Technological Innovations in Developing Economies

Having gone through three stages of the Bayesian Structural Equation Modelling, the model summarizes the significant determinants of successful commercialization (measured by commercialization commitment) in developing economies. Public awareness, accessibility of the new product, test marketing, information dissemination, feedback use (customer involvement) as well as marketing staff motivation emerged as the key determinants. PPPs, as determined by the level of sectoral support, emerged as the other key determinant of successful commercialization.

8.5 RECOMMENDATIONS

Based on the study's findings, the researcher makes the following recommendations:

- The national progress regarding technological innovation commercialization is low. Despite the reality that both private and public research institutes are contributing extensively to the new technology development and technical improvements, the commercialization of the output results is still limited. The Commercialization Fund (CF) has only been put in place as a matter of policy but is not fully functional. The market is ready to embrace Zimbabwe's own innovations thus there is a need to bring life to the CF (through the national budget) and treat commercialization as one of the top priority areas in policy implementation.
- The study also confirmed that external institutional support is still lacking and / or limited with respect to the provision of the support mechanisms needed for researchers and research institutes to bring their ideas and output to the market. There is also a need to identify overlapping functional roles of relevant ministries and funding agencies to facilitate commercialization of technological innovations. There is a further need to continuously review other existing mechanisms with a potential of constraining successful commercialization of innovations in Zimbabwe. Some mechanisms should be put in place to provide avenues or opportunities to develop and harness commercialization expertise and skills.
- Though few PPPs have been established to be in operation in service delivery, the findings of this study imply that there are limited understandings surrounding the value that could be unlocked in commercializing research institutes' innovations through PPPs. Thus there is a need to educate various research institutes of the "miracles" a carefully-run PPP can work in getting new TIs to the market. In a modern, competitive world where standardization is slowly taking precedence due to globalization forces, the only way is to cooperate with other firms. Some have even opted to collaborate with their competitors, a relatively new move described as *"copetition"* (Ahokangas *et al.*, 2014; Naidoo, 2013; Seo *et al.*, 2010) all meant to prove that the combined efforts of two or more far surpass individual efforts (1+1=3).
- To the few existing PPPs in Zimbabwe, the findings show that there is lack of integrative frameworks for the management, and success of the PPPs. Anchored on promoting ideal collaborations in which all key values are honoured, the study recommends a working collaboration in which the public research partner concentrates on research and development, while the private partner uses market analytics to focus on getting the product to the market. There is also a need for the partners to collaborate extensively with a support network which

should include, among other players, 'business angels', venture capitalists, patent specialists, lawmakers, city planners, private companies and so on.

- There is a need for the provision of institutional support to administer the risks associated with ineffective allocation, and usage of the already scarce commercialization funds.
- Research institutes should make efforts to set up a one-stop centre for dissemination of information and "news" on commercialization efforts.
- State policy makers should set up effective institutes specifically for monitoring and evaluating (M & E) commercialization successes and / or failures in both private and public institutes. These Commercialization Monitoring and Evaluation Institutes (CMEIs) should be permitted to operate independently and should be allowed to make recommendations for improvement based on their M & E findings.
- The identification of determinants which can lead to successful commercialization of technological innovations in developing countries can indeed lead to the creation of sustainable economies in most third world African countries such as Zimbabwe. If successfully commercialized, technological innovations have the potential to create jobs, can provide an important example for researchers – both current and aspiring, and in turn boost the economic growth rate. For this reason, it is essential that educationists and policymakers recognize the need to embed commercialization training and skills development, when considering tertiary education strategy especially.
- There is also need to consider awarding some incentives for commercialization. There is need to increase opportunities and rewards for commercialization institutions and individuals within them. It is also important to address disincentives such as finance allocation mechanisms, promotion criteria that discount external research commercialization. For instance shareholder options in spin off companies or retaining significant royalties from Intellectual Property (IP) to the research team are some of the ways researchers can be motivated to work towards commercialization.
- International and regional networks need to be fully utilized.- Through the Research Council of Zimbabwe (RCZ), the country currently has linkages with counterpart Science and Technology organizations in other countries and memberships with the International Council of Scientific Unions, (ICSU), Common Wealth Science Council, Nam Centre for Science and Technology. These organizations need to be utilized as they offer valuable support and expertise in sharing knowledge, which could go a long way especially in commercializing Zimbabwe's innovations in foreign lands.

- Research institutes should engage in demand-oriented research. The study ruled out the relationship between commercial success and understanding customer expectations but it remained firm in emphasizing the importance of enacting on customer expectations. It is thus pertinent that research institutes undertake research in areas that fit in areas of interest to business as they constitute the bulk of the up-takers of the innovations. It is also necessary to undertake research for a proven market because without a genuine market for the outcome of the research outcomes, success will remain rare.
- Relevant members should be sent for commercialization exchange programmes. Commercialization sabbaticals promote greater researcher and innovation mobility between different industries and also across various research institutes internationally.
- Research institutes should engage in customer education programmes for the new technological innovations. This should be complemented by ensuring adequate and equitable distribution of the new products, taking into account the often overlooked rural market. As outlined in a study emerging from this thesis (Saruchera *et al.*,2014*b*), consumer awareness could be improved through:
    - Trade fairs.
    - The use of public information dissemination in print and electronic media.
    - Engaging the industry in forums and workshops. Offer them "trial products" and encourage them to do some comparative experiments and give feedback, thus helping the marketing firms make improvements (adjustments) if need be.
    - Making use of testimonials - why not use the satisfied consumer to convince another potential consumer?

This "market education" recommendation is made in line with Wood and Lynch, Jr. (2002:416) who empirically established that (prior) knowledge plays a critical role in new product learning thus in turn, enhancing (new) product adoption.

- **Recommendations emerging from the study's participants or respondents include the following:**
    - There is a need for policy makers to implement favourable government policy that supports Research, Development and Commercialization (R & D – C), for instance by reducing tariffs on vital raw materials and equipment imports, improving accountability of the Innovation and Commercialization Fund, patent laws and intellectual property

protection administration, limiting or banning the importation of cheap, low quality finished substitutes and offering tax exemptions for new local products launched.

- The government should facilitate the development of technology incubation services such as Science Parks, Techno-Parks and Entrepreneurial Centres.
- Research institutes should establish Strategic Business Units (SBUs) specifically dedicated to commercialization activities. This will ensure the institutes have full-time personnel responsible for all marketing activities.
- Institutes should exhaust all promotional tools available to create awareness. They should fully utilize emerging social media communication platforms such as Facebook, Twitter and Whatsapp to create new product awareness.
- Research institutes should seek advice and learn from successful experience locally, regionally and / or internationally. Long established experiences from the USA, as illustrated in literature (Bremer, 2001; Mowery, *et al.*, 2001), show that formalized policies that actively promote transfer of government funded innovations from research agencies to the private sector were put in place. The previously discussed Science and Technology Policy should thus be sensitive to the requirements of the research institutions

8.6 METHODOLOGICAL IMPLICATIONS

In recognition of two major research methodology crises; the crisis of legitimation (i.e. reliability and validity issues) and the representation crisis (i.e. the extent to which it is possible to represent the world view) (Parsons, 1995), the study utilized mixed methodology. Based on the strengths obtained from this approach to research, the study thus challenges future researchers in commercialization to fully utilize the approach so as to obtain holistic view of issues under study.

8.7 LIMITATIONS OF THE STUDY AND PROPOSALS FOR FUTURE RESEARCH

Contrary to a couple of various past studies (*e.g.* Antioko & Kleijnen, 2010; Nerkar & Shane, 2007; Pollock *et al.,* 2007; Rothamel *et al.,* 2007), the current study does not support the prediction that good acceptance of a new product depends on understanding market expectations (Hypothesis H_6). However, this study had a limitation regarding this finding. For instance, the study's data collection instrument did not have a proper scale of detecting and / or measuring the research institutes' level of understanding of market expectations nor measuring the fulfillment of those expectations within the market. Ideally, the

instrument could include such a measure to enhance the reliability of this result. Participants may also have understood the instrument better had the distinction between "understanding" and "fulfilling" market expectations been clarified. A possible improvement of the study could incorporate these variables, definitions and distinctions in the data collection instrument.

The study tackled the role of Private-Public Partnerships (PPPs) in commercialization of technological innovations from a purely exploratory perspective; hence the results ought to be interpreted with vigilance. Based on this exploratory nature, not much inference should be made about the broader population of these partnerships in developing economies. In addressing the PPPs objective, the study hopefully makes a self-effacing but vital contribution to the understanding of how PPPs can be applied to commercialization in the same manner that they are successfully applied in service delivery.

Much work, however, remains to provide a framework which developing economies can adopt in terms of how to create a platform for PPPs, responsibility or role distribution, management issues as well as "best practices" for running PPP's. Thus, any future research efforts must help to address these and should also consider the impact of new product adoption culture, and state policy on commercialization. It also emerged from the study that certain new products fail on the market not because they are of quality but due to widespread falsehoods (myths) in place of real facts. Though few such studies emerged from this thesis with particular emphasis on green fuel consumption (Chitakunye *et al.*, 2014; Saruchera *et al.*, 2014*b*), it is important that such studies be extended to other forms of technological innovations invented in developing economies such as Zimbabwe.

Even though the study unearthed various barriers to the successful commercialization of technological innovations in Zimbabwe, the findings highlighted that that certain firms are making it through the market. Further research could also be conducted to assess the effectiveness of strategies being used by different research institutions in their attempts to commercialize their output.

REFERENCES

Aarikka-Stenroos, Leena, & Sandberg, Birgitta. (2012). From new-product development to commercialization through networks. *Journal of Business Research, 65*(2), 198-206.

Aarikka-Stenroos, L., Sandberg, B., & Lehtimäki, T. (2014). Networks for the commercialization of innovations: A review of how divergent network actors contribute. *Industrial Marketing Management, 43*(3), 365-381.

Abell, D.F., & Hammond, J.S. (1979). *Strategic Marketing Planning* (Vol. Prentice-Hall). New Jersey: P.

Abrahamson, E., & Rosenkopf, L. (1993). Institutional and competitive bandwagons: using mathematical-modeling as a tool to explore innovation diffusion *Academy of Management Journal, 18*(3), 487–517.

Adler, Niclas. (1999). *Managing complex product development: Three approaches.* Stockholm School of Economics.

Advisors, The Research. (2006). Sample Size Table. doi:http://research-advisors.com/images/subpage/SSTable.jpg – Accessed on: February 12, 2013.

Ahokangas, Petri, Horneman, Kari, Posti, Harri, Matinmikko, Marja, Hanninen, Tuomo, Yrjola, Seppo, & Goncalves, Vania. (2014). *Defining "co-primary spectrum sharing"—A new business opportunity for MNOs?* Paper presented at the Cognitive Radio Oriented Wireless Networks and Communications (CROWNCOM), 2014 9th International Conference.

Akintoye, A., Beck, M., Hardcastle, C., Chinyio, E., & Asenova, D. (2001). *The financial structure of Private Finance Initiative projects.* Paper presented at the 17th ARCOM Annual Conference, Salford University, Manchester.

Akkawi, A. (2010). INSEAD—PPPs as Policy Instruments. http://campuses.insead.edu/abu_dhabi/events/PPPPresentation29.11.10.pdf.

Amabile, T.M. (1988). A model of creativity and innovation in organizations, *Research in Organizational Behavior*, *10*,123–167.

Amabile, T. M., Conti, R., Coon, H., Lazenby, J., & Herron, M. (1996). Assessing the work environment for creativity. *Academy of Management Journal*, 39: 1154–1184.

Ancarani, A. and Capaldo, G. (2001). Management of standardized public services: a comprehensive approach to quality assessment. *Managing Service Quality, 11*(3), 331-341.

Andrew, J.P., & Sirkin, H. (2003). Innovating for cash. *Harvard Business Review*, 76–85.

Anokhin, S., Wincent, J, & Frishammar, J. (2011). A conceptual framework for misfit technology commercialization. *Technological Forecasting and Social Change, 78*(6), 1060-1071.

Antioco, M., & Kleijnen, M. (2010). Consumer adoption of technological innovations: Effects of psychological and functional barriers in a lack of content versus a presence of content situation. *European Journal of Marketing, 44*(11/12), 1700 - 1724.

Apil, A.R. (2006). Foreign product perceptions and country of origin analysis across Black Sea: Studies on Azerbaijan, Bulgaria, Georgia, Russia, and Turkey. *IBSU International Refereed Multi-disciplinary Scientific Journal, 1*, 22-38.

Aram, J.D., Lynn, L.H. & Reddy, N.M. (1992). Institutional relationships and technology commercialization: Limitations of market based policy. *Research Policy 21*(5), 409-421.

ARC, Australian Research Council. (2000). *Research in the National Interest: Commercializing University research in Australia*. Australia: Australian Government.

Asenova, D. and Beck, M. (2003). The UK financial sector and risk management in PFI projects: a survey. *Public Money & Management, 23*, 195-203.

Attewell, P. (1992). Technology diffusion and organizational learning: The case of business computing. *Organization Science, 3*(1), 1-19.

Audretsch, D., & Feldman, M. (1996). R&D spillovers and the geography of innovation. *American Economic Review, 86*, 630-640.

Audretsch, D., Lehmann, E., & Warning, S. (2005). University Spillovers and New Firm Location. *Research Policy, 34*(7), 1113-1122.

Avdeitchikova, S. & Coenen, L. (2004). *Commercialization of Clean Technology – towards a combined micro- and macro-level framework* Paper presented at the GSB Conference, South Africa. www.gsbblogs.uct.ac.za/gsbconfernce/files/2011/09/coenen-and-avdeitchikova

Avdeitchikova, S., & Coenen, L. (2013). *Commercializing clean technology innovations–the emergence of new business in an agency-structure perspective* (No. 2013/6). Lund University, CIRCLE-Center for Innovation, Research and Competences in the Learning Economy.

Badshah, A. (1998). *Good Governance for Environmental Sustainability, Public Private Partnerships for the Urban Environment Programme (PPPUE), United Nations Development Program*. New York: UNDP.

Bank, European Investment. (2000). The European Investment Bank and Public Private Partnerships. *Newsletter of the International Project Finance Association, 1*, 3-4.

Bauer, E. (2001). *Effects of patenting and licensing on research*. Paper presented at the National Academies Board on Science, Technology, and Economic Policy Committee on Intellectual Property Rights in the Knowledge-Based Economy, USA.

Bayus, B. L. (1994). Are product life cycles really getting shorter? *Journal of Product Innovation*

Management 11(4), 300-308.

Behboudi, Mehdi, Jalili, Nazanin , & Mousakhani, Morteza (2011). Examine the Commercialization Research Outcomes in Iran: A Structural Equation Model. *International Journal of Business and Management, 6*(7), 261-275.

Bell, E. (2008). ETHICS. In R. Thorpe, & R. Holt (Eds.) *The SAGE Dictionary of Qualitative Management Research* (pp. 88-90). London, United Kingdom: SAGE Publications Ltd.

Benedetto, C.A. (1999). Identifying the key success factors in new product launch *Journal of Product Innovation Management, 16*, 530-544.

Bennett, E. (1998). *Public–private Co-operation in the Delivery of Urban Infrastructure Services (Water and Waste), Background paper: Public Private Partnerships for the Urban Environment Programme (PPPUE), UNDP/Yale Collaborative Programme*. New York: United Nations Development Programme.

Bentler, Peter M, & Chou, Chih-Ping. (1987). Practical issues in structural modeling. *Sociological Methods & Research, 16*(1), 78-117.

Bergman, Manfred Max. (2008). *Advances in Mixed Methods Research* doi:http://dx.doi.org/10.4135/9780857024329

Bianchi, M., Chiesa, V. & Frattini, F. (2009). Exploring the microfoundations of External Technology Commercialization: a dynamic capabilities perspective. *European Journal of Innovation Management 12*(4), 444-469.

Bilkey, Warren J, & Nes, Erik. (1982). Country-of-origin effects on product evaluations. *Journal of international business studies*, 89-99.

Blair, D., & Hitchens, D. (1998). *Campus Companies – U.K. and Ireland* Aldershot, UK: Ashgate.

Börzel, Tanja A, & Risse, Thomas. (2005). Public-private partnerships: Effective and legitimate tools of international governance. *Reconstituting Political Authority. Complex Sovereignty and the Foundations of Global Governance, Toronto*, 195-216.

Brabec, Christoph J. (2004). Organic photovoltaics: technology and market. *Solar energy materials and solar cells, 83*(2), 273-292.

Brannen, J. (2009). PROLOGUE: Mixed methods for novice researchers: Reflections and themes. *International Journal of Multiple Research Approaches, 3*(1), 8-12

Braun, J. von, & Kennedy, E. (1994). Agricultural commercialization, economic development, and nutrition.

Brester, Gary W, Marsh, John M, & Atwood, Joseph A. (2004). Distributional impacts of country-of-origin labeling in the US meat industry. *Journal of Agricultural and Resource Economics*, 206-

227.

Brewerton, Paul M, & Millward, Lynne J. (2001). *Organizational research methods: A guide for students and researchers*: Sage.

Brinkerhoff, D. and Brinkerhoff, J. (2004). Partnerships between international donors and non-governmental development organizations: opportunities and constraints. *International Review of Administrative Sciences, 70*(2), 253-270.

Bruland, K. (1995). Patterns of resistance to new technologies in Scandinavia: an historical perspective", in Bauer, M. (Ed.), Resistance to New Technology. *Cambridge University Press, Cambridge*.

Burgess, T.F. (2001). *A general introduction to the design of questionnaires for survey research*. Thousand Oaks: CA: Sage.

Burns, John, Warren, Liz, & Oliveira, João. (2014). Business Partnering: Is It All That Good? *Controlling & Management Review, 58*(2), 36-41.

Buse, Stephan, Tiwari, Rajnish, & Herstatt, Cornelius. (2010). Global innovation: An answer to mitigate barriers to innovation in small and medium-sized enterprises? *International Journal of Innovation and Technology Management, 7*(03), 215-227.

Bush, V. (1945). As we may think. *The Atlantic monthly, 176*(1), 101-108.

Byrne, Barbara M. (2013). *Structural equation modeling with AMOS: Basic concepts, applications, and programming*: Routledge.

Caerteling, Jasper S., Halman, Johannes I. M., & Dorée, André G. (2008). Technology Commercialization in Road Infrastructure: How Government Affects the Variation and Appropriability of Technology. *Journal of Product Innovation Management, 25*(2), 143-161. doi: 10.1111/j.1540-5885.2008.00289.x

Caerteling, Jasper S., Halman, Johannes I. M., Song, Michael, Dorée, André G., & Van Der Bij, Hans. (2013). How Relevant Is Government Championing Behavior in Technology Development? *Journal of Product Innovation Management, 30*(2), 349-363. doi: 10.1111/j.1540-5885.2012.01003.x

Camuffoo, Arnaldo, & Volpato, Giuseppe. (2002). Partnering in the global auto industry: the Fiat-GM strategic alliance. *International journal of automotive technology and management, 2*(3), 335-352.

Carree, M., & Thurik, A. (1999). *Industrial Structure and Economic Growth, in D. Audretsch and A. Thurik, eds., Innovation, Industry Evolution, and Employment*. New York: Cambridge University Press.

Cavusgil, S Tamer. (1998). International partnering: a systematic framework for collaborating with

foreign business partners. *Journal of International Marketing*, 91-107.

Chadee, Doren, & Roxas, Banjo. (2013). Institutional environment, innovation capacity and firm performance in Russia. *Critical perspectives on international business, 9*(1/2), 19-39.

Chakravorti, B. (2004). The new rules for bringing innovations to market. *Harvard Business Review, 82*(3), 58-67.

Chandran, V.G.R. (2010). R & D commercialization challenges for developing countries: the case of Malaysia. *Tech Monitor* (Nov - Dec 2010), 25 - 30.

Chandran, V.G.R. , Farha, A.G., & Veera, P. . (2008). The commercial- ization of research results among researchers in public universities and research institutions. *Asian Profile, 36*(3), 235-250.

Chandran, V.G.R., Farha, A.G., & Veera, P. (2009). The role of collaboration, market and intellectual property rights awareness in university technology commercialization *International Journal of Innovation and Technology Management, 6*(4), 363-378.

Chandran, V.G.R., Rasiah, R., & Wad, P. (2009). Malaysian manufacturing systems of innovation and internationalization of R & D: CBDS Working Paper Series, Working Paper nr. 11 *Copen-Hagen Business School, Denmark*.

Charmaz, K. (2006). *Constructing grounded theory: A practical guide through qualitative analysis*. Thousand Oaks, CA: Sage.

Chen, C.-J. (2009). Technology commercialization, incubator and venture capital, and new venture performance. *Journal of Business Research, 62*, 93–103.

Cheng, Eddie WL. (2001). SEM being more effective than multiple regression in parsimonious model testing for management development research. *Journal of management development, 20*(7), 650-667.

Chesbrough, H. (2009). *Open Innovation and Universities*. Paper presented at the What Industry Wants from Universities, San Diego, CA.

Chesbrough, H.W. (2003). *Open Innovation*: Harvard Business School Press.

Chesbrough, H. W., & Rosenbloom, R.S. (2002). The role of the business model in capturing value from innovation: evidence from Xerox Corporation's technology spin-off companies. *Industrial Corporate Change, 11*(3), 529-555.

Chetsanga, C.J. (2004). *An Analysis of the Cause and Effect of the Brain Drain in Zimbabwe*. SIRDC. Zimbabwe.

Chiesa, Vittorio, & Frattini, Federico. (2011). Commercializing Technological Innovation: Learning from Failures in High-Tech Markets. *Journal of Product Innovation Management, 28*, 437-454.

Chitakunye, Pepukayi, Saruchera, Fanny, Derera, Evelyn, & Tarkhar-Lail, Amandeep. (2014). Managing

Consumer Mythology: The Green Consumption of E10 Fuel. *Mediterranean Journal of Social Sciences, 5*(20), 1098.

Christensen, C. (2000). *The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business*. New York: Harper Business.

Cierpicki, S., Wright, M., & Sharp, B. . (2000). Managers' knowledge of marketing principles: The case of new product development. *Journal of Empirical Generalisations in Marketing Science 5*(3), 771-790.

Cohen, W.M., & Levinthal, D.A. (1990). Absorptive-capacity: a new perspective on learning and innovation. *Administrative Science Quartery, 35*(1), 128-152.

Coldwell, D. and Herbst, F. (2004). *Business Research*. Cape Town: Juta and Co. Ltd.

Commission, European. (2011). New Public-Private Partnerships for Research in the Manufacturing, Construction and Automotive Sectors: European PPP Research Supports *Economic Recovery Progress Report: July 2011*.

Coolican, Hugh. (2009). *Research methods and statistics in psychology*: Routledge.

Cooper, D.R. and Schindler, P.S. (2008). *Business Research Methods, 10th Edition*. London.

Cooper, G. (2000). Strategic marketing planning for radically new products. *Journal of Marketing, 64*, 1-16.

Cooper, G., & Kleinschmidt, E. (1995). Benchmarking the firm's critical success factors in new product development. *Journal of Product Innovation Management, 12*, 374–391.

Cooper, R. G. (1984). The Performance Impact of Product Innovation Strategies. *European Journal of Marketing, 18*(5), 5-53.

Corkindale, D. (2008). Towards a business model for commercializing innovative new technology. *Innovative Marketing, 4*(2), 7 - 15.

Courtois, B. A. (2004). Commercialization. (May 2004). Retrieved from http://www.itac.ca/pdf/04may_issue_commercialization.pdf website:

Creswell, John W. (2010). When should I choose a mixed methods approach? video recording. Thousand Oaks, CA: SAGE Publications, Inc.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*, 297-334.

Crozier, J. (2010). *Smarter Urbanization Requires Innovative Public-Private Partnerships*

Dailami, M. and Klein, M. (1997). *Government support to private infrastructure projects in emerging markets, in Irwin, T. (ed.) World Bank Latin American and Caribbean Studies Viewpoints: Dealing with Public Risk in Private Infrastructure*. Washington: World Bank.

Dean, T.J. and McMullen, J.S. . (2007). Toward a theory of sustainable entrepreneurship: Reducing

environmental degradation through entrepreneurial action. *Journal of Business Venturing, 22*(1), 50-76.

Debackere, K. and Veugelers, R. (2005). The role of academic technology transfer organizations in improving industry science links. *Research Policy, 34*, 321-342.

Decter, D., Bennet, D., & Leseure, M. (2007). University to business technology transfer - UK and USA comparisons. *Technovation, 3*(27), 145 - 155.

Department of Trade and Industry (2007) Innovation in Services, *DTI Occasional Paper No. 9*, June, HMSO.

Di Benedetto, A. (1999). Identifying the key success factors in new product launch. *Journal of Product Innovation Management, 16*(6), 530–544.

Di Zhang, D. (2015, January). Beyond Market Orientation: Exploring the Role of Entrepreneurial Orientation. In *Proceedings of the 2007 Academy of Marketing Science (AMS) Annual Conference* (pp. 258-258). Springer International Publishing.

D'orazio, P., Monaco, E., & Palumbo, R. (2007). Determinants of academic entrepreneurial intentions in technology transfer process: an empirical test. *Journal of Applied Psychology, 95*, 939-953.

Doyle, Mona. (1984). "New Ways of Measuring Value" *Progressive Grocer-Value, Executive Report* (pp. 15-19).

Drucker, P.F. (1986). *Innovation and entrepreneurship: practice and principles*: Harper & Row.

Drucker, Peter F. (2007). Innovation and entrepreneurship.

Drucker-Godard, C, Ehlinger, S, and Grenier, C. (2001). *Validity and Reliability', in Rhiétart, T. & Wauchope, S. (eds)*. London, England: SAGE Publications Ltd.

Echambi, R., Campbell, B., & Agarwal, R. (2006). Encouraging best practice in quantitative management research: an incomplete list of opportunities. *Journal of Management Studies, 43*, 1801–1821.

Eisenhardt, K.M., & Martin, J.A. (2000). Dynamic capabilities:what are they? *Strategic Management Journal*(Special Issue 21), 1105-1121.

Elofson, G. and Robinson, W.N. (2007). Collective customer collaboration impacts on supply-chain performance. *International Journal of Production Research, 45*, 2567–2594.

Enkel, E. , Gassmann, O., & Chesbrough, H.W. (2009). Open R&D and open innovation: exploring the phenomenon R&D Management. *R & D Management, 39*, 311-316.

Etgar, M. (2008). A descriptive model of the consumer co-production process. *Journal of the Academy of Marketing Science, 36*, 97–108.

Europa. (2010). Developing Public Private Partnerships http://europa.eu/legislation_summaries/employment_andsocial_policy/eu2020/em0026_en.htm

Everitt, B.S. and Wykes, T. (Ed.) (1999). London: Arnold.

Ferguson, W. K. (2011). Commercialization of university research for technology-based economic development. *Industry and Higher Education, 25*(3), 161-172.

Finnerty, J.D. (1996). *Project Financing: Asset-based Financial Engineering*. New York: John Wiley & Sons.

Ford, George, Koutsky, Thomas, & Spiwak, Lawrence. (2007). A valley of death in the innovation sequence: an economic investigation. *Available at SSRN 1093006*.

Frattini, Federico, De Massis, Alfredo, Chiesa, Vittorio, Cassia, L, & Campopiano, G. (2012). Bringing to Market Technological Innovation: What Distinguishes Success from Failure. *International Journal of Engineering Business Management, 4*, 1-11.

Freund, York P. (1988). Critical success factors. *Strategy & Leadership, 16*(4), 20-23.

Friar, J.H., & Ballachandra, R. . (1999). Spotting the customer for Emerging Technologies. *Research-Technology Management, Industrial Research Institute* (July-August).

Frilet, M. (1997). Some universal issues in BOT projects for public infrastructure. *International Construction Law Review, 14*(4), 499-512.

Gans, J., Hsu, D.H., and Stern, S. (2007). The Impact of Uncertain Intellectual Property Rights on the Market For Ideas: Evidence From Patent Grant Delays, NBER Working Papers 13234.

Garrido-Rubio, A., & Polo-Redondo, Y. (2005). Tactical launch decisions: influence on innovation success / failure. *Journal of Product & Brand Management, 14*(1), 29 - 38.

Gbadamosi, A. (2009). Cognitive dissonance: The implicit explication in low-income consumers' shopping behaviour for "low-involvement" grocery products. *International Journal of Retail & Distribution Management*, 37 (12), 1077-1095.

Geels, F., Hekkert, M. and Jacobsson, S. . (2008). The dynamics of sustainable innovation journeys. *Technology Analysis and Strategic Management, 20*(5), 521-536.

Gillham, Bill. (2000). *Case study research methods*: Continuum.

Godin, B. (2005). *The linear model of innovation: a historical construction of an analytical framework: Project on the history and sociology of S & T Statistics, Working Paper no. 30*

Godø, Helge, & Børing, Pål. (2010). International comparison of what innovative manufacturing firms do for promoting innovation.

Goldsmith, H. R. (1995). *A Model for Technology Commercialization*. Paper presented at the Mid-Continent Regional Technology Transfer Centre Affilliate's Conference, NASA Johnson Space Centre, Houston.

Goldsmith, H. R. (2003). Commercialization – the process of turning innovations into enterprises

American Venture Magazine.

Gourville, J. (2006). Eager seller and stony buyers: Understanding the psychology of new-product adoption. *Harvard Business Review, 84*(6), 98-106.

Grant, T. (1996). Keys to successful public–private partnerships. *Canadian Business Review, 23*(3), 27-28.

Greene, J. (2005). Mixed Methods. In S. Mathison (Ed.). In S. Mathison (Ed.), *Encyclopedia of Evaluation: Mixed Methods* (pp. 256-257). Thousand Oaks, CA: Sage Publications, Inc.

Greer, Charles R., & Lei, David. (2012). Collaborative Innovation with Customers: A Review of the Literature and Suggestions for Future Research. *International Journal of Management Reviews, 14*, 63-84.

Greis, Noel P, Dibner, Mark D, & Bean, Alden S. (1995). External partnering as a response to innovation barriers and global competition in biotechnology. *Research Policy, 24*(4), 609-630.

Grimsey, D. and Lewis, M.K. (2002). Evaluating the risks of public private partnerships for infrastructure projects. *International Journal of Project Management, 20*, 107-118.

Grimsey, D. and Lewis, M.K. (2004). *Public Private Partnerships: The Worldwide Revolution in Infrastructure Provision and Project Finance*. Cheltenham: Edward Elgar.

Guest, G., Bunce, A., and Johnson, L. (2006). How many interviews are enough? : An experiment with data saturation and variability. *Field Methods, 18*, 59-82.

Gupta, Vishal K, Guo, Chun, Canever, Mario, Yim, Hyung Rok, Sraw, Gaganjeet Kaur, & Liu, Ming. (2014). Institutional environment for entrepreneurship in rapidly emerging major economies: the case of Brazil, China, India, and Korea. *International Entrepreneurship and Management Journal, 10*(2), 367-384.

Ha°kansson, H. , & Waluszewski, A. (2001). *Co-evolution in technological development: the role of friction.* Paper presented at the IMP-Conference, Oslo. www.impgroup.org

Haahr, Mads. (2010). Random. org: True random number service. *School of Computer Science and Statistics, Trinity College, Dublin, Ireland. , 10*. doi: http://www. random. org

Haakansson, Haakan, and Wootz, Bjorn. Supplier Selection in an International Environment - An Experimental Study. *Journal of Marketing Research, 12*(February 1975), 46 - 51.

Hall, D. (2008a). PPPs in the EU – A Critical Appraisal, available at: www.psiru.org/publicationsindex.asp 1-32. www.psiru.org/publicationsindex.asp

Hall, D. (2008b). Public-Private Partnerships (PPPs): Summary Paper. 1-26. www.psiru.org/publicationsindex.asp

Han, C Min, & Terpstra, Vern. (1988). Country-of-origin effects for uni-national and bi-national

products. *Journal of international business studies*, 235-255.

Haque, S.M. (2004). Governance based on partnership with NGOs: implications for development and empowerment in rural Bangladesh. *International Review of Administrative Sciences, 70*(2), 271-290.

Harmon-Jones and Harmon-Jones, (2000). Cognitive Dissonance Theory after 50 Years of Development, *Psychology* 38 (1)

Hart, D. (2003). *The Emergence of Entrepreneurship Policy: Governance, Startups, and Growth in the U.S. Knowledge Economy* (Vol. ed.). New York: Cambridge University Press.

Hartley, R. H. (2005). *Marketing mistakes and successes*. Hoboken, NJ: John Wiley & Sons. .

Hatcher, Larry. (1994). *A step-by-step approach to using the SAS system for factor analysis and structural equation modeling*: Sas Institute.

Hausman, A., & Johnston, W. J. (2014). The role of innovation in driving the economy: Lessons from the global financial crisis. *Journal of Business Research, 67*(1), 2720-2726.

Haws, Kelly L, & Bearden, William O. (2006). Dynamic pricing and consumer fairness perceptions. *Journal of Consumer Research, 33*(3), 304-311.

Hayter, Christopher Scott (2010). *The Open Innovation Imperative: Perspectives on Success From Faculty Entrepreneurs: PhD Dissertation* U.S.A.: UMI Dissertation Publishing.

Hellowell, Mark, Price, David, & Pollock, Allyson M. (2008). The use of private finance initiative (PFI) public private partnerships (PPPs) in Northern Ireland: NIPSA.

Henry, G.T. (1990). *Practical Sampling*. Newbury Park, CA: Sage.

Hoon, Min Sang, & Villalobos, Katherine M. (2013). The Influence of Korean Wave and Country of Origin Effect on Korean Product Evaluations. *한국국제경영관리학회 학술발표대회 논문집*, 45-66.

Howell, J.M. , & Higgins, C.A. (1990). Champions of techno- logical innovation. *Administrative Science Quarterly, 35*(2), 317–341.

Hultink, E. J., A. , Griffin, S. , Hart, & Robben, H. S. J. (1997). Industrial new product launch strategies and product development performance. *Journal of Product Innovation Management 14*(6), 243–257.

Hultink, E.J., Hart, S., Robben, H.S.J. , & Griffin, A. . (2000). Launch decisions and new product success: an empirical comparison of consumer and industrial products. *Journal of Product Innovation Management, 17*, 5-23.

Hultink, E.J., & Robben, H.S.J. (1999). Launch strategy and new product performance: an empirical examination in The Netherlands. *Journal of Product Innovation Management, 16*, 545-556.

Im, S., & Workman Jr, J. P. . (2004). Market orientation, creativity, and new product performance in high-technology firms. *Journal of marketing, 68*(2), 114-132.

Industry Canada (2006)., 'Key Small Business Statistics:How Many Businesses are There in Canada?'.

Jacoby, J., R. W. & Jerry C. Olson. (1985). *Perceived Quality*. Lexington: MA: Lexington Books.

Jaffe, Eugene D, & Nebenzahl, Israel D. (2001). *National image and competitive advantage: the theory and practice of country-of-origin effect*: Copenhagen Business School Press.

Jamali, Dima. (2004). Success and failure mechanisms of public private partnerships (PPPs) in developing countries: Insights from the Lebanese context. *The International Journal of Public Sector Management, 17*(5), 414-430.

Jamali, Dima. (2007). A study of customer satisfaction in the context of a public private partnership. *International Journal of Quality & Reliability Management, 24*(4), 370-385.

Jefferies, Marcus (2006). Critical success factors of public private sector partnerships: A case study of the Sydney SuperDome. *Engineering, Construction and Architectural Management, 13*(5), 451-462.

Jefferies, M., Gameson, R. , & Rowlinson, S. (2002). Critical success factors of the BOOT procurement system: reflection from the Stadium Australia case study. *Engineering, Construction and Architectural Management, 9*(4), 352–361.

JG., Klein. (2002). Us versus them, or us versus everyone? delineating consumer aversion to foreign goods. *Journal of Interntional Business Studies, 33*(2), 345-363.

Johansson, J. K. (1993). Missing a strategic opportunity: managers' denial of country-of-origin effect. *Product-country images: Impact and role in international marketing*, 77-86.

Johansson, A., Kisch, P., & Mirata, M. (2005). Distributed economies–a new engine for innovation. *Journal of Cleaner Production*, *13*(10), 971-979.

Johansson, Johny K, Douglas, Susan P, & Nonaka, Ikujiro. (1985). Assessing the impact of country of origin on product evaluations: a new methodological perspective. *Journal of Marketing Research*, 388-396.

Jolliffe, IT. (1972). Discarding variables in a principal component analysis. I: Artificial data. *Applied statistics*, 160-173.

Jolly, V.K. (1997). *Commercializing New Technologies: Getting from Mind to Market*. Boston, MA: Harward Business School Press.

Jones, I. , Zamani, H. , & Reehal, R. (1996). *Financing models for new transport infrastructure*. Luxembourg: OPEC.

Jones-Evans, D. (1997). *Entrepreneurship research and the emerald isle-a review of small business studies in the Republic of Ireland* Avebury, Aldershot.

Jr., Rosenau MD. (2001). Radical innovation: how mature companies can outsmart upstarts. *Journal of Product Innovation Management, 18*(4), 278–279.

Kalaian, S. . (2008). Research Design. In Paul J. Lavrakas (Ed.) *Encyclopedia of Survey Research Methods: Research Design* (pp. 725-732). Thousand Oaks, CA: Sage Publications, Inc.

Kang, J., Gwon, S., Hong, S., Kim, Y., & Chao, K. (2011). Determinants of the Technology Commercialization of the Government-Sponsored Firms: Empirical Evidence from Korean Manufacturing. *IEEE*.

Kanter, R.M. (1999). From spare change to real change. *Harvard Business Review, 77*(2), 122-132.

Kayal, A.A. (2008). National innovation systems a proposed framework for developing countries. *International Journal of Entrepreneurship and Innovation Management, 8*(1), 74–86.

Kaynak, Erdener, Kucukemiroglu, Orsay, & Hyder, Akmal S. (2000). Consumers' country-of-origin (COO) perceptions of imported products in a homogenous less-developed country. *European Journal of Marketing, 34*(9/10), 1221-1241.

Keller, D.K. (2006). In The Tao of Statistics: A Path to Understanding (with No Math) *Truth - Validity* (pp. 60-64). Thousand Oaks, CA: SAGE Publications, Inc.

Kelly, J. (2005). The dilemma of the unsatisfied customer in a market model of public administration. *Public Administration Review, 65*(1), 76-84.

Kerwer, Dieter. (2002). *Standardising as Governance: The Case of Credit-Rating Agencies* Lanham MD: Rowman & Little-field.

Kim, S.K., Lee, B.G., Park, B.S. & Oh, K.S. (2011). The effect of R & D, technology commercialization capabilities and innovation performance. *Technological and Economic Development of Economy, 17*(4), 563-578.

Klompmaker, Jay E. (1976). Test Marketing in New Product Development. *Harvard Business Review, 54*(3), 128-138.

Knight, John G, Holdsworth, David K, & Mather, Damien W. (2007). Country-of-origin and choice of food imports: an in-depth study of European distribution channel gatekeepers. *Journal of International Business Studies, 38*(1), 107-125.

Kodama, Fumio. (1995). *Emerging Patterns of Innovation: Sources of Japan's Technological Edge*. Boston, MA: Harvard Business School Press.

Krejcie, R.V. and Morgan, D.W. (1970). Determining Sample Size for Research Activities. *Educational and Psychological Measurement, 30,* 607-610.

Kropp, F. and Zolin, R. (2005). Technological Entrepreneurship and Small Business Innovation Research Programs. *Academy of Marketing Science Review, 7,* 1-14.

Kwaramba, P. (2009, July 10, 2009). Can commercializing technology stimulate economic recovery? , *The Financial Gazette*.

Lam, Son K, Ahearne, Michael, Mullins, Ryan, Hayati, Babak, & Schillewaert, Niels. (2013). Exploring the dynamics of antecedents to consumer–brand identification with a new brand. *Journal of the Academy of Marketing Science, 41*(2), 234-252.

Landry, R., Amara, N., & Oumit, M. (2002). *Research Transfer in Natural Science and Engineering: Evidence from Canadian Universities*. Paper presented at the 4th Triple Helix Conference, Copenhagen, Denmark.

Laranja, M. (2009). The development of technology infrastructure in Portugal and the need to pull innovation using proactive intermediation policies. *Technovation, 29*(1), 23-34.

Lee, Jin Kyun, Lee, Byung-Kwan, & Lee, Wei-Na. (2013). Country-of-origin fit's effect on consumer product evaluation in cross-border strategic brand alliance. *Journal of Business Research, 66*(3), 354-363.

Lee, Y., & Gaertner, R. (1994). Technology Transfer to Industry: a Large Scale Experiment with Technology Development and commercialization. *Policy Studies Journal, 22*(2), 384–399.

Lehmkuhl, Dirk. (2000). *Commercial Arbitration - A Case of Private Transnational Self-Governance?* (Preprint, 2000/1 ed.). Bonn: Max-Planck-Projektgruppe Recht der Gemeinschaftsgüter.

Leitch, C., & Harrison, R. (2005). Maximizing the potential of university spin-outs: the development of second-order commercialization activities. *R & D Management, 35*(3), 257-272.

Leonard-Barton, D.L. (1988). Implementation as mutual adaptation of technology and organizations. *Research Policy, 17*.

Li, Bing, Akintoye, Akintola, Edwards, Peter J, & Hardcastle, Cliff. (2005). Critical success factors for PPP/PFI projects in the UK construction industry. *Construction management and economics, 23*(5), 459-471.

Lichtenthaler, U. (2009). Absorptive capacity, environmental turbulence, and the complementarity of organizational learning processes. *Academy of Management Journal, 52*, 822–846.

Lichtenthaler, U. (2011). Open innovation: past research, current debates, and future directions. *Academy of Management Perspectives, 25*, 79-93.

Lichtenthaler, U. & Ernst, H. (2007). External technology commercialization in large firms: results of a quantitative benchmarking study. *R & D Management 37*(5), 383-397.

Likert, Rensis. (1932). A technique for the measurement of attitudes. *Archives of psychology*.

Lim, Kar H, Hu, Wuyang, Maynard, Leigh J, & Goddard, Ellen. (2013). US Consumers' Preference and Willingness to Pay for Country-of-Origin-Labeled Beef Steak and Food Safety Enhancements.

Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie, 61(1), 93-118.

Link, A. N. and Scott, T.J. (2010). Government as entrepreneur: Evaluating the commercialization success of SBIR project. *Research Policy, 39*(589-601).

Link, A. N., Siegel, D. S., & Wright, M. (2014). *The Chicago Handbook of University Technology Transfer and Academic Entrepreneurship*. University of Chicago.

Lipstein, Benjamin. (1968). Test marketing: a perturbation in the market place. *Management Science, 14*(8), B-437-B-448.

Liu, X. (2008). China's development model: an alternative strategy for technological catch-up (D. o. I. Development, Trans.) (pp. 32). Oxford: University of Oxford.

Liyanage, Shantha, Greenfield, Paul F, & Don, Robert. (1999). Towards a fourth generation R&D management model-research networks in knowledge management. *International journal of technology management, 18*(3), 372-393.

Lo, Chih-cheng, Wang, Chun-hsien, Chien, Pei-Yu, & Hung, Chien-Wei. (2012). An empirical study of commercialization performance on nanoproducts. *Technovation, 32*(3), 168-178.

Lockett, A, & Wright, M. (2005). Resources, Capabilities, Risk Capital and the Creation of University Spin-Out Companies: Technology Transfer and Universities' Spin-out Strategies. *Research Policy, 34*(7), 1043-1057.

Loureiro, Maria L, & Umberger, Wendy J. (2007). A choice experiment model for beef: What US consumer responses tell us about relative preferences for food safety, country-of-origin labeling and traceability. *Food policy, 32*(4), 496-514.

Ltd, SAGE Publications. *Introduction: Whither Mixed Methods?. Advances in Mixed Methods Research. SAGE Publications Ltd*. London: SAGE Publications Ltd.

Ltd, SAGE Publications. *Validity and Reliability. Doing Management Research. SAGE Publications Ltd*. London, England: SAGE Publications Ltd.

Lund-Thomsen, Peter. (2009). Assessing the impact of public–private partnerships in the global south: The case of the Kasur Tanneries Pollution Control Project. *Journal of Business Ethics, 90*(1), 57-78.

MacVaugh, J. , & Schiavone, F. (2010). Limits to the diffusion of Innovation: A literature review and integrative model. *European Journal of Innovation Management, 13*(2), 197-221.

Maheswaran, D., Chen, C. Y., & He, J. (2013). Nation equity: Integrating the multiple dimensions of country of origin effects. *Review of Marketing Research, 10*, 153-189.

March, J.G. . (1991). Exploration and exploitation in organizational learning. *Organizational Science, 2*(1), 71-87.

Markham, Stephen K, Ward, Stephen J, Aiman‐Smith, Lynda, & Kingon, Angus I. (2010). The valley of death as context for role theory in product innovation. *Journal of Product Innovation Management, 27*(3), 402-417.

Markman, G.D., Siegel, D.S., & Wright, M. (2008). Research and Technology Commercialization. *Journal of Management Studies, 45*(8), 1401-1423.

Martinelli, A., Meyer, M., & Tunzelmann, N.V. (2008). Becoming an Entrepreneurial University? A Case Study of Knowledge Exchange Relationships and Faculty Attitudes in a Medium-sized, Research-oriented University. *Journal of Technology Transfer, 33*, 259-283.

Maruyama, Masayoshi, Wu, Lihui, Cadogan, JohnW, & Cadogan, JohnW. (2014). The relevance of retailer country-of-origin to consumer store choice: Evidence from China. *International Marketing Review, 31*(5).

Mason, Mark. (2010). *Sample Size and Saturation in PhD Studies Using Qualitative Interviews.* Paper presented at the Forum: Qualitative Social Research.

McGrath, R.G., Tsai, M.H., Venkataraman, S., & I.C., MacMillan. (1996). Innovation, competitive advantage, and rent: a model and test. *Management Science, 42*(3), 389-403.

McNeil, R.D., Lowe,J., Mastroianni, T., Cronin, J., Ferk, D. (2007). Barriers to Nanotechnology Commercialization, Report Prepared for U.S. Department Of Commerce Technology Administration, U.S. Department of Commerce or KT Consulting, Inc.

McQuaid, Ronald W. , & Scherrer, Walter (2010). Changing reasons for public–private partnerships (PPPs). *Public Money & Management, 30*(1), 27-34.

Merges, R.P. , & Nelson, R.R. (1990). On the complex eco- nomics of patent scope. *Columbia Law Review, 90*(4), 839–916.

Michell, W. and K. Singh. (1996). Survival of businesses using collaborative relationships to commercialize complex goods. *strategic Management Journal, 17*, 169-195.

Mielenz, Jonathan R. (2001). Ethanol production from biomass: technology and commercialization status. *Current Opinion in microbiology, 4*(3), 324-329.

Miller, D.C. and Salkind, N.J. (2002). *Sampling 6th edn*. Thousand Oaks, CA: SAGE Publications, Inc.

Miller, W.L. , & Moriss, L. (1999). *Fourth generation R & D* New York: John Wiley & Sons.

Millier, P., & Palmer, R. (2001). Turning innovation into profit. *Strategic Change, 10*(Mar- April), 87-93.

Mitchell, W., & Singh, K. (1996). Survival of businesses using collaborative relationships to commercialize complex goods. *Strategic Management Journal, 17*(3), 169-195

Mohr, J., Sengupta, S., & Slater, S. (2001). Marketing of High-Technology Products and Innovations *Upper Saddle River, New Jersey, Prentice Hall: Pearson Education, Inc.*

Mohr, J., Sengupta, S. , & Slater, S. (2005). *Marketing of High-Technology Products and Innovations, 2nd edition*. Upper saddle River, New Jersey: Pearson Education Inc.

Mohr, J. and Spekman, R. (1994). Characteristics of partnership success: partnership attributes, communication behaviour, and conflict resolution techniques. *Strategic Management Journal, 15*, 135–152.

Moore, G. (2002). *Crossing the chasm: marketing and selling high-tech products to mainstream customers*. New York: HarperBusiness.

Morallos, D. and Amekudzi, A. (2008). The state of the practice of value for money analysis in comparing public private partnerships to traditional procurements. *Public Works Management and Policy, 13*(2), 114-125.

Mørk, B.E. , Hoholm, T., & Aanestad, M. (2006). Constructing, enacting and packaging innovations, Vol. 9 No. 4, pp. 444-465. *European Journal of Innovation Management,, 9*(4), 444-465.

Morris, C. (2003). *Quantitative Approaches in Business Studies (6th edn)*. Harlow: Financial Times Prentice Hall.

Morris, T. and Wood, S. (1991). Testing the survey method: continuity and change in British industrial relations. *Work, Employment and Society, 5*(2), 259–282.

Mouraviev, N., & Kakabadse, N.K. (2012). Conceptualising public-private partnerships:-A critical appraisal of approaches to meanings and forms. *Society and Business Review, 7*(3), 260-276.

Mowery, D., Nelson, R., Sampat, B., & Ziedonis, A. (2001). The growth of patenting and licensing by US universities: An assessment of the effects of the Bayh-Dole Act of 1980. *Research Policy, 30*, 99-119.

Mowery, D., Nelson, R., Sampat, B., & Ziedonis, A. (2004). *Ivory Tower and Industrial Innovation: University-Industry Technology Transfer Before and After the Bayh-Dole Act*. Palo Alto: Stanford Business Books.

Mustafa, A. (1999). Public-private partnership: an alternative institutional model for implementing the private finance initiative in the provision of transport infrastructure. *Journal of Project Finance, 5*, 64-79.

Nagashima, A. (1970). A Comparison of Japanese and U.S. Attitudes Toward Foreign Products. *Journal of Marketing, 34*(January 1970), 68-74.

Naidoo, Soogandhree. (2013). A management dilemma: internal copetition versus internal collaboration. doi: dspace.up.ac.za

NCPPP. (2003). *The National Council for Public-Private Partnerships: NCPPP White Paper*. Washington, DC.

Nerkar, A., & Shane, S. (2003). When do startups that exploit patented academic knowledge survive? *International Journal of Industrial Organization, 21*(9), 1391-1410.

Nerkar, A., & Shane, S. (2007). Determinants of invention commercialization: an empirical examination of academically sourced inventions. *Strategic Management Journal, 28*, 1155-1166.

Nerkar, A.A., McGrath, R.G., & MacMillan, I.C. . (1996). Three facets of satisfaction and their influence on the performance of innovation teams *Journal of Business Venturing, 11*(3), 167–188.

Newell, Peter and Niamh, Garvey. (2005). Corporate accountability to the poor—Assessing the effectiveness of community-based strategies. *Development in Practice, 15*(3-4), 389–494.

Nijkamp, P., van der Burch, M. , & Vindigni, G. (2002). A comparative institutional evaluation of public-private partnerships in Dutch urban land-use and revitalization projects. *Urban Studies, 39*(10), 1865-1880.

Nonaka, Ikujirō, & Takeuchi, Hirotaka. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation*: Oxford University Press, USA.

Norris, K., & Vaizey, J. (1973). *The economics of research and technology* London: George Allen & Unwin Ltd.

Nussbaum, Bruce, Berner, Robert, & Brady, Diane. (2005). Get creative. *Business Week, 3945*, 60-68.

Öberg, C., & Shih, T. T. Y. (2014). Divergent and convergent logic of firms: Barriers and enablers for development and commercialization of innovations. *Industrial Marketing Management, 43*(3), 419-428.

O'Gorman, C., Byrne, O., & Pandya, D. (2008). How Scientists Commercialise New Knowledge via Entrepreneurship. *Journal of Technology Transfer, 33*(23-43).

O'Shea, R., Allen, T., Chevalier, A., & Roche, F. (2005). Entrepreneurial Orientation, Technology Transfer, and Spin-off Performance of U.S. Universities. *Research Policy, 34*(7), 994-1009.

O'Shea, Rory P, Chugh, Harveen, & Allen, Thomas J. (2008). Determinants and consequences of university spinoff activity: a conceptual framework. *The Journal of Technology Transfer, 33*(6), 653-666.

Oblak, R., Bistričić, A., & Jugović, A. (2013). Public-private partnership - management model of Croatian seaports. *Management, 18* (1), 79-102.

OECD. (2003). *Turning Science into Business, Patenting and Licensing at Public Research Organisations*. Paris: OECD.

Ojanen, V. and Hallikas, J. (2009). Inter-organisational routines and transformation of customer relationships in collaborative innovation. *International Journal of Technology Management, 45*, 306–322.

Osborne, S.P. (Ed.). (2000). *Public-Private Partnerships: Theory and Practice in International Perspective* (Vol. London): Routledge.

Ovaska, Claire, Morris, Margaret, & Hooper, Helen. (2014). LibGuides. PY3102: Social Psychology. APA Research Paper Outline.

Parsons, Claire. (1995). The impact of postmodernism on research methodology: implications for nursing. *Nursing inquiry, 2*(1), 22-28.

Patton, M.Q. (1990). *Qualitative Evaluation and Research Methods*. Newbury Park, California: Sage Publications.

Payne, A.F., Storbacka, K. , & Frow, P. . (2008). Managing the co-creation of value. *Journal of the Academy of Marketing Science, 36*, 83–96.

Pellikka, J., & Lauronen, J. (2007). Fostering commercialisation of innovation in small high technology firms. *International Journal of Technoentrepreneurship, 1*(1), 92 - 108.

Pellikka, J. T., & Malinen, P. (2014). Business Models In The Commercialization Processes Of Innovation Among Small High-Technology Firms. *International Journal of Innovation and Technology Management*, *11*(02).

Pellikka, J. , & Virtanen, M. (2004). *The problems of commercialization in small and medium-sized information technology firms* Paper presented at the 13th Nordic Conference on Small Business Research, 10–12 June, Tromso, Norway.

Pennings, J.M., & Hirianto, F. (1992). Technological networking and innovation implementation. *Organizational Science, 3*(3), 356-382.

Perunovic, Z., & Christiansen, T.B. (2005). Exploring Danish Innovative Manufacturing Performance. *Journal of Technovation, 25*, 1051 - 1058.

Peterson, R.A. (2000). *Constructing effective questionnaires*. Thousand Oaks: CA: Sage Publications, Inc

Petti, C., & Zhang, S. (2011). Factors influencing technological entrepreneurship capabilities: Towards an integrated research framework for Chinese enterprises. *Journal of Technology Management in China, 6*(1), 7 - 25.

Phan, P. , & Siegel, D. S. (2006). The effectiveness of university technology transfer: lessons learned. *Foundations and Trends in Entrepreneurship, 2*(2), 77-144.

Pinto, R. (2010). Mixed Methods Design. In Neil J. Salkind (Ed.) *Encyclopedia of Research Design: Mixed Methods Design* (pp. 813-819). Thousand Oaks, CA: SAGE Publications, Inc.

Pollock, A. M., Price, D. , & Player, S. (2007). An examination of the UK Treasury's evidence base for cost and time overrun data in UK value-for money policy and appraisal. *Public Money & Management, 27*(8), 127–133.

Pongsiri, N. (2002). Regulation and public private partnerships. *The International Journal of Public Sector Management, 15*(6), 487-495.

Porter, Michael E. (1990). *The Competitive Advantage of Nations*. New York, NY: The Free Press.

Powers, Joshua B. (2003). Commercializing academic research: Resource effects on performance of university technology transfer. *The Journal of Higher Education, 74*(1), 26-50.

Prenkert, Frans. (2012). Commentary to "From new-product development to commercialization through networks". *Journal of Business Research, 65*(2), 207-209.

Prodan, I., & Drnovsek, M. (2010). Conceptualizing academic-entrepreneurial intention: An empirical test. *Technovation, 30*(5-6), 332-347.

Qiao, L., Wang, S.Q., Tiong, R.L.K. , & Chan, T.S. (2001). Framework for critical success factors of BOT projects in China. *Journal of Project Finance, 7*(1), 53–61.

Quinn, Gerald Peter, & Keough, Michael J. (2002). *Experimental design and data analysis for biologists*: Cambridge University Press.

Raines, L. (2006). SBIR Commercialization Success Factors http://63.65.212.51/smallbusiness/.../TechNetWestVirginiaOctober2006

Rao, Akshay R, & Monroe, Kent B. (1989). The effect of price, brand name, and store name on buyers' perceptions of product quality: an integrative review. *Journal of marketing Research*, 351-357.

Rao, Akshay R, & Monroe, Kent B. (1989). The effect of price, brand name, and store name on buyers' perceptions of product quality: an integrative review. *Journal of marketing Research*, 351-357.

Rasiah, R., & Chandran, V.G.R. (2009). University-industry collaboration in the automotive, biotechnology and electronics firms in Malaysia *Seoul Journal of Economics, 22*(4), 529-550.

Rasmussen, E., Moen, Ø., & Gulbrandsen, M. (2006). Initiatives to promote commercialization of university knowledge. *Technovation, 26*(4), 518-533.

RCZ. (2014). Zimbabwe's Research Institutes Database. Accessed online at: www.rcz.ac.zw/database

Realini, CE, Font i Furnols, M, Sañudo, C, Montossi, F, Oliver, MA, & Guerrero, L. (2013). Spanish, French and British consumers' acceptability of Uruguayan beef, and consumers' beef choice associated with country of origin, finishing diet and meat price. *Meat science, 95*(1), 14-21.

Renda, A. and Schrefler, L. (2006). Public-private partnerships: models and trends in the European Union 1-15.

Richins, M. , & Bloch, P. . (1986). After the new wears off: the temporal context of product involvement. *Journal of Consumer Research, 13*(September), 280-285.

Roberts, E. (1991). *Entrepreneurs in High Technology*. New York: Oxford University Press.

Robertson, T.S. (1967). The Process of Innovation and Diffusion of Innovation. *Journal of Marketing,*

31(14-19).

Robson, c. (2002). *Real World Research: A Resource for Social Scientists and Practitioner-Researchers: 2nd Edition*. Oxford: Blackwell.

Rogers, E. (1995). *Diffusion of Innovations, 4th ed.* New York, NY: Free Press.

Rogers, E. (2003). *Diffusion of innovations*. New York: Free Press.

Rosa, J. and A. Rose. (2007). Report on Interviews on the Commercialisation of Innovation. *Ottawa, Science, innovation and Electronic Information Division, Statistics Canada*, 10-14.

Rothaermel, F., & Thursby, M. (2005). Incubator Firm Failure or Graduation? The Role of University Linkage. *Research Policy, 34*(3), 1076-1090.

Rothaermel, F. T. , Agung, S. D. , & Jiang, L. (2007). University entrepreneurship: a taxonomy of the literature. *Industrial and Corporate Change, 16*, 691–791.

Rothaermel, F.T. & Hill, C.W.L. (2005). Technological discontinuities and complementary assets: A longitudinal study of industry and firm performance. *Organizational Science, 16*(1), 52-70.

Rothwell, R. (1977). The characteristics of successful innovators and technically progressive firms (with some comments on innovation research). *R&D Management, 7*(3), 191-206.

Rowlinson, S. and McDermott, P. . (Eds). *Procurement Systems: A Guide to Best Practice*. London: E. and F.N. Spon.

Sadka, E. (2007). Public-private partnerships – a public economics perspective. *CESifo Economic Studies, 53*(3), 466-490.

Saeed, Faiza, Grunert, Klaus G, & Therkildsen, Margrethe. (2013). How product trial changes quality perception of four new processed beef products. *Meat science, 93*(1), 119-127.

SAGE Publications, Inc. *14 Conversations About Three Things. SAGE Quantitative Research Methods. SAGE Publications, Inc*. Thousand Oaks, CA: SAGE Publications, Inc.

Samson, K. , & Gurdon, M. (1993). University Scientists as Entrepreneurs: A Special Case of Technology Transfer and High-tech Venturing. *Technovation, 13*(2), 63-71.

Saruchera, Fanny, & Chitakunye, Pepukayi. (2013). *The Commercialization of E10 Fuel in Zimbabwe: Impediments, Perceptions, Realities and the Way Forward*. Paper presented at the RCZ 9th International Research Symposium: Driving socio-economic development through research output, Harare: Zimbabwe.

Saruchera, Fanny, Phiri, Maxwell A., & Chitakunye, Pepukayi. (2014b). Consumer perceptions about E10 fuel in Zimbabwe: managerial implications. *Journal of Contemporary Management, 11*, 470 – 490.

Saruchera, Fanny, Tukuta, Marian, Ndoda, Gladys R, & Sikwila, Mike N. (2014a). Driving Industry

Growth through Academic Excellence: A Study on the Strategic Contribution of University-Industry Knowledge Transfer in Revamping Manufacturing SMEs in Developing Economies. *Mediterranean Journal of Social Sciences, 5*(14), 252.

Saunders, M., Lewis, P., & Thornhill, A. (2007). *Research Methods for Business Students, Fourth Edition*. Edinburgh Gate: England: Pearson Education Limited.

Saunders, M., Lewis, P., & Thornhill, A. (2009). *Research Methods for Business Students: 5th Edition*: Prentice Hall, Financial Times.

Schedler, Andreas, Larry, Diamond , & Plattner, Marc F. (1999). *The Self-Restraining State—Power and Accountability in New Democracies*. London: Lynne Rienner.

Schilling, M. A. (2005). *Strategic management of technological innovation*. New York: McGraw-Hill.

Schlange, L.E. (2009). *Stakeholder Identification in Sustainability Entrepreneurship: The Role of Managerial and Organizational Cognition*: Greenleaf Publishing.

Schostak, John. (2006). *Data Collection and Analysis, Second Edition*. England: Open University Press.

Schumpeter, J.A. (1934). *The Theory of Economic Development: An Inquiry Into Profits, Capital, Credit, Interest, and the Business Cycle* Cambridge, MA: Harvard University Press.

Schumpeter, Joseph Alois. (1934). *The theory of economic development: an inquiry into profits, capital, credit, interest, and the business cycle*: Transaction Books.

Schumpeter, J.A. (1950). *Capitalism, Socialism, and Democracy* (3rd Ed. ed.). New York: Harper & Row.

Sedjari, A. (2004). Public-private partnerships as a tool for modernising public administration. *International Review of Administrative Sciences, 70*(2), 291-306.

Sekaran, U. (2003). *Research Methods for Business. 4th Edition*: John Wiley and Sons, Inc.

Selwyn, N. (2003). Apart from technology: understanding people's non-use of information and communication technologies in everyday life. *Technology in Society, 25*, 99-116.

Seo, Joung Hae, Shin, Jin-Kyo, Choi, Han-Yong, & TAWADA, Makoto. (2010). Environmental Uncertainty, Copetition Strategy, Inter-functional Competition, and Organizational Performance in Korea. *地域学研究, 40*(4), 899-920.

Shah, S., & Corley, K. (2006). Building better theory by bridging the quantitative-qualitative divide. *Journal of Management Studies, 43*, 1821–1836.

Shane, S. (2001*a*). Technological opportunities and new firm creation. *Management Science, 47*(2), 205-220.

Shane, S. (2001*b*). Technology regimes and new firm formation. *Management Science, 47*, 1173-1190.

Shane, S. (2004). *Academic Entrepreneurship: University Spinoffs and Wealth Creation*.

Northampton, MA: Edward Elgar.

Shane, S. , & Stuart, T. (2002). Organizational endowments and the performance of university start-ups. *Management Science, 48*(1), 154-170.

Shillito, M Larry. (1994). *Advanced QFD: linking technology to market and company needs*: John Wiley & Sons.

Sichelman, T. (2010). Markets for Patent Scope. *IP Theory, 1*, 42.

Siegel, D. S., Wright, M., and Lockett, A. (2007). The rise of entrepreneurial activity at universities: organizational and societal implications. *Industrial and Corporate Change, 16*(4), 489-504.

Siegel, Donald S., Waldman, David A., & Link, Albert N. (2003). Assessing the Impact of Organizational Practices on the Productivity of University Technology Transfer Offices: An Exploratory Study. *Research Policy, 32*(1), 27-48.

SIRDC. (2013). About SIRDC and its Institutes. Retrieved June, 5, 2013, from http://www.sirdc.ac.zw/

Sirkin, H. , & Andrew, J.P. (2003). Innovating for Cash *Harvard Business Review*.

Slater, Stanley F., & Mohr, Jakki J. (2006). Successful Development and Commercialization of Technological Innovation: Insights Based on Strategy Type. *The Journal of Product Innovation Management, 23*, 26 - 33.

Smith, S. , & Pech, R.J. (2006). A template for commercializing science and facilitating innovation: A Case study of Victoria, Australia. *European Journal of Innovation Management, 9*(3), 279 - 299.

Smits, Ruud, & Kuhlmann, Stefan. (2004). The rise of systemic instruments in innovation policy. *International Journal of Foresight and Innovation Policy, 1*(1), 4-32.

Sohn, S. Y., & Moon, T. H. (2003). Structural equation model for predicting technology commercialization success index (TCSI). *Technological Forecasting and Social Change, 70*(9), 885-899.

Soleimanpour, Mohammad Reza, Hosseini, Seyed Jamal F, Mirdamadi, Seyed Mehdi, & Sarafrazi, Alimorad. (2012). Affective factors contributing to entrepreneurship potential of nanotechnology in agricultural sector of Iran. *African Journal of Business Management, 6*(19), 5969-5974.

Stein, S.W. (1995). Construction financing and BOT projects. *International Business Lawyer, 23*(4), 173-180.

Stevens, G., Burley, J. and Divine, R. (1999). Creativity (plus) business discipline (equals) higher profits faster from new product development. *Journal of Product Innovation Management, 16*, 455-468.

Stonehouse, J.H., Hudson, A.R. , & O'Keefe, M.J. (1996). Private–public partnerships: the Toronto Hospital experience. *Canadian Business Review, 23*(2), 17-20.

Supphellen, M., and Ritternburg, T.L. (2001). Consumer ethnocentrism when foreing products are better.

Psychology & Marketing, 19(9), 907-927.

Sutton, John. (2001). *Technology and market structure: theory and history*: MIT press.

Takhar, A. & Chitakunye, P. (2012). Rich descriptions: Evoking Informant Self-Reflexivity in Marketing and Consumer Research. *Journal of Marketing Management, 28*(7), 912-935.

Talke, Katrin, & Hultink, Erik Jan. (2010). The Impact of the Corporate Mind-set on New Product Launch Strategy and Market Performance. *Journal of Product Innovation Management, 27*(2), 220-237.

Tassey, G. (1991). The Functions of Technology Infrastructure in a Competitive Economy. *Research Policy, 20*, 234-243.

Teece, D.J. (1986). Profiting from technological innovation: implications for integration, collaboration, licensing and public policy. *Research Policy, 16*(6), 285-305.

Teece, D.J., Pisano, G., & Shuen, A. (1997). Dynamic Capabilities and strategic management. *Strategic Management Journal, 18*(7), 509-533.

Tiwari, Rajnish, & Buse, Stephan. (2007). *Barriers to innovation in SMEs: Can the internationalization of R&D mitigate their effects?* Paper presented at the Proceedings of the First European Conference on Knowledge for Growth: Role and Dynamics of Corporate R&D-CONCORD.

Trobia, A. (2008). Sampling. In P. J. Lavrakas (Ed.), *Encyclopedia of Survey Research Methods* (pp. 784-785). Thousand Oaks: Sage Publications, Inc.

Tushman, M.L., & Anderson, P.C. (1986). Technological discontinuities and organisational environments. *Administrative Science Quartery, 31*(3), 439-465.

University, Carnegie Mellon. (2002). Innovation Exchange, a new Collaborative Model for Tech Transfer. *Carnegie Mellon News, 9*(8).

Varki, Sajeev, & Colgate, Mark. (2001). The role of price perceptions in an integrated model of behavioral intentions. *Journal of Service Research, 3*(3), 232-240.

Verworn, B., Herstatt, C., & Nagahira, A. (2008). The fuzzy front end of Japanese new product development projects: impact on success and differences between incremental and radical projects. *R & D Management, 38*(1), 1-19.

Vining, A. and Boardman, A. (2008). Public-private partnerships: eight rules for governments. *Public Works Management & Policy, 13*(2), 149-161.

Vohora, A. , Wright, M., & Lockett, A. (2004). Critical Junctures in the Development of University High-Tech Spin-Out Companies. *Research Policy, 33*, 147-175.

Voulgari, Sotiria, Tsafarakis, Stelios, Grigoroudis, Evangelos, & Matsatsinis, Nikolaos. (2013). Consumer-oriented new product development: a review of recent developments. *International*

Journal of Information and Decision Sciences, 5(4), 364-392.

Wade, J. (1996). A community-level analysis of sources and rates of technological variation in the microprocessor market. *Academy of Management Journal 39*(5), 1218–1244.

Weckowska, Dagmara Maria. (2010). *The Role Of Intermediaries in the Commercialisation of Academic Research: A Practice-Based Approach*. Paper presented at the DRUID-DIME Academy Winter 2010 PhD Conference, Aalborg, Denmark.

West, Joel, & Bogers, Marcel. (2010). Contrasting innovation creation and commercialization within open, user and cumulative innovation. *San José State University*.

Wettenhall, R.A. (2003). The rhetoric and reality of public-private partnerships. *Public Organization Review: A Global Journal, 3*, 77-107.

Widdus, R. (2001). Public private partnerships for health: their main targets, their diversity and their future directions. *Bulletin of the World Health Organization, 79*(4), 713-720.

Winsler, Adam, Burchinal, Margaret R, Tien, Hsiao-Chuan, Peisner-Feinberg, Ellen, Espinosa, Linda, Castro, Dina C., De Feyter, Jessica. (2014). Early development among dual language learners: The roles of language use at home, maternal immigration, country of origin, and socio-demographic variables. *Early Childhood Research Quarterly*.

WIPO. (2004). World Invention Patents. *www.wipo.org* – Accessed October 12, 2012.

Witters, Louis, Marom, Revital, & Steinert, Kurt. (2012). The Role of Public-Private Partnerships in Driving Innovation: The Global Innovation Index.

Wonglimpiyarat, Jarunee. (2010). Commercialization strategies of technology: lessons from Silicon Valley. *The Journal of Technology Transfer, 35*(2), 225-236.

Wood, Matthew S. (2011). A process model of academic entrepreneurship. *Business Horizons, 54*(2), 153-161.

Wood, S.L. & Lynch, J.G. (Jr.). (2002). Prior knowledge and complacency in new product learning. *Journal of Consumer Research, 29*(3), 416 - 426.

Wright, M., Clarysse, B, Lockett, A, & Binks, M. (2006). University Spin-Out Companies and Venture Capital. *Research Policy, 35*(4), 481-501.

Wright, V. (1994). Reshaping the state: the implications for public administration. *Western European Politics, 17*(3), 102-137.

Wüstenhagen, R., Hamschmidt, J., Sharma, S. & Starik, M. . (2008). *Sustainable Innovation and Entrepreneurship*. Cornwall, UK: Edward Elgar Publishing Limited.

Wyles, Katy. (2001). *Commercialization of Public Sector Research*. Australia: Science, Engineering and Innovation Council.

Xia, Lan, Monroe, Kent B, & Cox, Jennifer L. (2004). The price is unfair! A conceptual framework of price fairness perceptions. *Journal of marketing, 68*(4), 1-15.

Yin, R. . (1994). *Case study research: Design and methods (2nd ed.)*. Beverly Hills, CA: Sage Publishing.

Yin, R.K. (2003). *Case Study Research: Design and Method (3rd edn)*. London: Sage.

Youngs, H, & Piggot, E. (2013). *The Merits of Triangulation: The Evaluation of New Zealand School Leadership Development Programs Using Mixed-Methods Research*. London, United Kingdom: SAGE Publications, Ltd.

Zahra, S. A. (1996). Technology strategy and new venture performance: a study of corporate-sponsored and independent biotechnology ventures. *Journal of Business Venturing, 11*, 289–321.

Zahra, S.A., & Nielsen, A.P. (2002). Sources of Capabilities, Integration and Technology Commercialization *Strategic Management Journal, 23*, 377–398.

Zaidi, S. J., & Naeem, T. (2005). Commercialization of government funded research results- problems and prescriptions- A case study of Pakistan. *Total Quality Management*.

Zairi, M. (1994). Innovation or Innovativeness? Results of a Benchmarking Study. *Total Quality Management, 5*(2), 27-44.

Zeithaml, Valarie A. (1988). Consumer perceptions of price, quality, and value: a means-end model and synthesis of evidence. *The Journal of Marketing*, 2-22.

Zhang, W.R., Wang, S.Q., Tiong, R.L.K., Ting, S.K. , & Ashley, D. (1998). Risk management of Shanghai's privately financed Yan'an Donglu tunnels. *Engineering, Construction and Architectural Management, 5*(4), 399-409.

Zhang, Xueqing. (2005). Critical success factors for public–private partnerships in infrastructure development. *Journal of Construction Engineering and Management, 131*(1), 3-14.

Zhou, Kevin Zheng, Kin, Chi, & Tse, David K. (2005). The effects of strategic orientations on technology-and market-based breakthrough innovations. *Journal of marketing*, 42-60.

Zikmund, W.G. (2000). *Business Research Methods (6th edn)*. Fort Worth, TX: Dryden Press.

Zimbabwe, (RCZ) Research Council of. (2013). Historical Background of RCZ. Retrieved June, 5, 2013, from http://www.rcz.ac.zw/index.php/en/about-rcz/background/history.html

Zucker, L., Darby, M, & Armstrong, J. (2002). Commercializing Knowledge: University Science, Knowledge Capture, and Firm Performance in Biotechnology. *Management Science, 48*(1), 138-153.

APPENDICES

Appendix 1: Ethical clearance certificate

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

28 January 2015

Mr Fanny Saruchera (212562263)
School of Management, IT and Governance
Pietermaritzburg Campus

Dear Mr Saruchera,

Protocol reference number: HSS/0157/013D
Project title: Determinants of Commercialization of Technological Innovations in Developing Economies: A Study of Zimbabwe's Research Institutes

Approval Notification – Amendment

This letter serves to notify you that your request for an amendment received on 06 November 2014 has now been approved as follows:

- Change in Supervisor

Any alterations to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form; Title of the Project, Location of the Study must be reviewed and approved through an amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

Best wishes for the successful completion of your research protocol.

Yours faithfully

Dr Shenuka Singh (Chair)

/ms

cc Supervisor: Dr Maxwell Phiri
cc Academic Leader Research: Prof B McAuthur
cc School Administrator: Ms D Cunynghame

Appendix 2: Informed consent form

UNIVERSITY OF KWAZULU-NATAL

School of Management, IT & Governance

Dear Respondent,

PhD Research Project

Researcher: Mr. Fanny Saruchera (+263 (0)772 436 775)

Supervisor: Dr. M.A. Phiri (+27(0)33-2605736)

Research Office: Ms P Ximba (+27 (0)31-2603587)

I, Fanny Saruchera, am a PhD student in the School of Management, IT & Governance , at the University of KwaZulu-Natal. You are invited to participate in a research project entitled: *Determinants of Commercialization of Technological Innovations in Developing Economies: a Study of Zimbabwe's Research Institutes*

The aim of this study is to investigate the factors facilitating and those that are inhibiting successful commercialization of innovations in Zimbabwe's private and public research institutes. Through your participation I hope to understand the customer perceptions on the state of innovations' commercialization in Zimbabwe, vis-à-vis their innovation expectations.

The results of this survey are intended to contribute to the development of a roadmap as an intervention tool in policy-making as a way forward based on the research findings.

Your participation in this project is voluntary. You may refuse to participate or withdraw from the project at any time with no negative consequence. There will be no monetary gain from participating in this research project. Confidentiality and anonymity of records identifying you as a participant will be maintained by the School of Management, IT & Governance, UKZN.

If you have any questions or concerns about participating in this study, please contact me or any of my supervisors at the numbers listed above.

It should take you about 15 - 20 minutes/s to complete the questionnaire. I hope you will take the time to complete the questionnaire.

Sincerely

Investigator's signature_____ Date_____

UNIVERSITY OF KWAZULU-NATAL

School of Management, IT & Governance

PhD Research Project

Researcher: Mr. Fanny Saruchera (0772 436 775)

Supervisor: Dr. M.A. Phiri (+27(0) 332605736)

Research Office: Ms P Ximba (031-2603587)

CONSENT

I_____(full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project. I understand that I am at liberty to withdraw from the project at any time, should I so desire.

_____ _____

Signature of Participant Date

This page is to be retained by researcher

Appendix 3: Research instrument 1 (Questionnaire for customers)

UNIVERSITY OF KWAZULU-NATAL
School of Management, IT & Governance

Dear Respondent,

PhD Research Project

Researcher: Mr. Fanny Saruchera (+263 (0)772 436 775)

Supervisor: Dr. M.A. Phiri (+27(0)33-2605736)

Research Office: Ms P Ximba (+27 (0)31-2603587)

Determinants of Commercialization of Technological Innovations in Developing Economies: a Study of Zimbabwe's Research Institutes

The purpose of this survey is to solicit information from customers and *would-be customers* regarding their thoughts on factors affecting the commercialization of technological innovations in Zimbabwe and their perceptions of Zimbabwe's technological innovations. The information and ratings you provide us with will go a long way in helping us establish the gap between customer expectations against the actual offerings on the market. The questionnaire should only take 15-20 minutes to complete. In this questionnaire, you are asked to indicate what is true for you, so there are no "right" or "wrong" answers to any question. Work as rapidly as you can. If you wish to make a comment please write it directly on the booklet itself. Make sure not to skip any questions.

Thank you for your participation.

In order to participate in this research, respondents have to be aware of, or must have been engaged in any transaction with, at least one of Zimbabwe's research institutes under study. The questionnaire is divided into three sections: the first section seeks some background information, followed by an exploration of market access and preference (if any), of the local technological innovations from different research institutes. Section C asks the respondents their attitudes and perceptions regarding Zimbabwe's innovations.

PLEASE ANSWER THE FOLLOWING QUESTIONS BY CROSSING ( ) THE RELEVANT BLOCK OR WRITING DOWN YOUR ANSWER IN THE SPACES PROVIDED.

FOR EXAMPLE:

Indicate your gender.

Male	1
Female	2

SECTION A – RESPONDENT BACKGROUND INFORMATION

This section seeks some background or biographical information. While we are aware of the sensitivity of the questions in this section, the information will allow us to compare groups of respondents. We assure you that your responses will remain anonymous. Your cooperation will be appreciated.

1. Indicate your gender.

Male	1
Female	2

2. What is your age group?

16 – 24	1
25 – 34	2
35 – 44	3
45 – 54	4
55 or older	5

3. What is your highest educational qualification?

Junior Certificate	1
O 'Level / Secondary School Certificate	2
A 'Level / High School Certificate	3
Post – secondary Diploma (s)	4
Bachelors Degree (s)	5
Post-graduate Degree (s)	6

4. How would you describe your area of residence?

Urban	1
Rural	2
Peri-urban	3

5. How would you describe your economic well-being?

Poor	1
Below Average	2
Average	3
Above Average	4
Flourishing	5

6. How big is your household? Indicate the number of people, including yourself, who live with you.

I stay alone	1
2	2
3	3
4	4
5	5
More than 5	6

7. How would you describe your role (s) in the family? **(You may indicate more than one role).*

Initiator	1
Buyer	2
Decision-maker / Decider	3
Influencer	4
Gatekeeper / Custodian	5

SECTION B

This section of the questionnaire explores your access to the market and preferences, if any, of the local technological innovations from different research institutes.

8. Please indicate which of the following research institutes you are aware of, and which ones you have had an encounter with for the past twelve months. (**You may indicate more than one institution).*

	Aware of it	Had an encounter with it
Biotechnology Research Institute	1	1
Harare Institute of Technology (Insti-brand)	2	2
Building Technology Institute	3	3
Environmental Sciences Institute	4	4
Food and Biomedical Technology Institute	5	5
Geo-Info Remote Sensing Institute	6	6
Production Engineering Institute	7	7
Electronics and Communications Institute	8	8
Cotton Research Institute	9	9
Coffee Research Station	10	10
Agronomy Research Institute	11	11

Pedstock Investments	12	12
Metallurgical Research Institute	13	13
Energy Technology Institute	14	14
Taisek Engineering	15	15
Other *(specify)*……	16	16

9. Have you ever purchased and / or used at least one new product from any of the above institutes for the past 12 to 24 months?

Yes	1
No	2

If you answered *"No"* to question 9, please answer question 10 only. If you answered *"Yes"* to question 9, please skip question 10 and continue from question 11.

10. Kindly rank, in order of importance, each of the following reasons for not purchasing and / or using the new products from any of Zimbabwe's research institutes for the past 12 to 24 months. Allocate rank 1 to the most important reason, 2 to the second important, rank 6 being the least important reason for not purchasing and / or using the new products from any of the Zimbabwe's research institutes.

Use each number (1 to 6) only once.

Reasons for not purchasing and / or using new products from the Research Institutes	*Rank*
I do not like local innovations – I prefer import substitutes.	
The products are expensive.	
The products are not readily available on the market – I cannot access the products easily.	
The new products are not well-communicated.	
Local products are not safe and user-friendly.	
I don't see anything unique about the local innovations.	

Thank you for your participation!

The following questions only pertain to respondents who have bought and / or used any new product(s) from the institutes indicated above.

11. Which of the following product categories have you purchased, accessed and / or used?
**(You may indicate more than one category).*

Electronic gadgets e.g. electronic de-feathering machine	1
Agricultural inputs e.g. SIRDAMAIZE, organic fertilizers	2
Food items & Herbs e.g. Instifoods, Insti-herbs (HIT) and related items	3
Farming implements and related equipment e.g. combine harvesters, hand pumps	4
Building materials e.g. Micro-concrete tiles	5
Auto parts and accessories e.g. body parts, fuel, lubricants, service parts	6
Other *(specify)…*	7

12. How often do you normally make your purchases from the institutes?

Frequently	1
Once in a month	2
Once in a year	3
Only when need arises	4
When I just come across the new product(s)	5

13. How do you normally get to know of the institute's new product?

Newspaper advertisements	1
Through friends	2
Internet	3
Through walk-ins	4
Through Launch campaigns & exhibitions	5
Other *(specify)…*	6

14. How important is each of the following variables to you when purchasing any of the new products from the different institutes you buy from? Indicate your answers using a 4-point scale where **1 = Totally unimportant (TU), 2 = Unimportant (UN), 3 = Important (IMP) and 4 = Very Important (VIMP)**

Variable	**TUN**	**UN**	**IMP**	**VIMP**
Low Price	1	2	3	4
Purchasing a local brand (100% Zimbabwean)	1	2	3	4
Purchasing an imported product	1	2	3	4
Product quality	1	2	3	4
Market education / communication	1	2	3	4
New product's originality	1	2	3	4
User-friendliness	1	2	3	4
Country of origin	1	2	3	4
New product's uniqueness	1	2	3	4
Market access	1	2	3	4

15. Do you consider yourself to be ethnocentric? **(An ethnocentric is someone who considers local products to be the best. He or she is proud of Zimbabwean products)*

Yes	1
No	2

SECTION C

This section seeks to explore your attitudes and perceptions regarding Zimbabwe's innovations.

To what extent do you agree with each of the following statements? Please indicate your responses using a 5-point scale where **1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Neutral (N), 4 = Agree (A) and 5 = Strongly Agree (SA).**

Statement	SD	D	N	A	SA
16. I prefer local new products to imports.	1	2	3	4	5
17. Zimbabwe's innovations are of high quality.	1	2	3	4	5
18. Zimbabwe's innovations are unique.	1	2	3	4	5
19. Zimbabwe's innovations are original.	1	2	3	4	5
20. The local innovations are affordable.	1	2	3	4	5
21. Research institutes give market support to their innovations.	1	2	3	4	5
22. Zimbabwe's innovations are market-driven.	1	2	3	4	5
23. Zimbabwe's innovations are technology-driven	1	2	3	4	5
24. It is easy to access new products in Zimbabwe.	1	2	3	4	5
25. Zimbabwe's innovations are safe.	1	2	3	4	5
26. Zimbabwe's innovations are user-friendly.	1	2	3	4	5
27. Zimbabwe's new products are well promoted/communicated.	1	2	3	4	5
28. I know where to buy and / or check for new products.	1	2	3	4	5
29. Zimbabwe's innovations meet my new product expectations.	1	2	3	4	5

30. What would you recommend research institutes do to improve commercialization of their new products in Zimbabwe?

(a) ……

(b) ……

Thank you for your participation.

Appendix 4: Research instrument 2 (Questionnaire for research institutes' staff)

UNIVERSITY OF KWAZULU-NATAL

School of Management, IT & Governance

Dear Respondent,

PhD Research Project

Researcher: Mr. Fanny Saruchera (+263 (0)772 436 775)

Supervisor: Dr. M.A. Phiri (+27(0)33-2605736)

Research Office: Ms P Ximba (+27 (0)31-2603587)

Determinants of Commercialization of Technological Innovations in Developing Economies: a Study of Zimbabwe's Research Institutes

The purpose of this survey is to solicit information from research institutes' staff regarding factors affecting the commercialization of technological innovations in Zimbabwe. The information and ratings you provide us with will go a long way in determining the state of commercialization of Zimbabwe's local innovations and will help us establish the gap between the actual situations within research institutes against market expectations. The questionnaire should only take 15-20 minutes to complete. In this questionnaire, you are asked to indicate what is true for you, so there are no "right" or "wrong" answers to any question. Work as rapidly as you can. If you wish to make a comment please write it directly on the booklet itself. Make sure not to skip any questions.

Thank you for your participation.

Please answer the following questions by crossing the relevant block or writing down your answer in the spaces provided.

FOR EXAMPLE:

Indicate your gender.

Male	1X
Female	2

1. Indicate your gender.

Male	1
Female	2

2. Indicate the sector that best describes your research institute.

Private	1
Public	2

3. Indicate your department or work unit within the institute.

Sales and Marketing	1
Production	2
Business Development	3
Technical	4
Public Relations	5
Other *(Specify)…*	6

4. For how long have you been with this institution?

Less than 1 year	1
2 to 5 years	2
6 to 10 years	3
11 to 15 years	4
More than 15 years	5

5. Do you have specific departments / units dealing with commercialization of technological innovations?

Yes	1
No	2

6. In your own view, what would you say is the attitude of researchers towards bringing their research output to the market place?

Willing	1
Reluctant	2
Demotivated	3
Not sure	4

7. What would you say about the state of new product development and the ultimate commercialization of such innovations in your institute?

Rate of New Product Development		**State of Commercialization**	
Poor	1	Poor	1
Average	2	Average	2
Above average	3	Above average	3
Good	4	Good	4
Excellent	5	Excellent	5

8. Has your company introduced any new product **to the market** in the past 12 to 24 months?

Yes	1
No	2

If you answered *"No"* to question 8, please answer question 9 only. If you answered *"Yes"* to question 8, please skip question 9 and continue from question 10.

9. Kindly rank, in order of importance, each of the following reasons for not managing to commercialize any new product(s) to the market in the past 12 to 24 months. Allocate rank 1 to the most important reason, 2 to the second important, rank 6 being the least important reason.

***Use each number (1 to 6) only once.**

Reasons for not managing to commercialize new products	*Rank*
Financial Constraints	
Lack of proper infrastructure	
Long time lag between research and commercialization	
Lack of interest in commercialization by scientists / researchers (the *"valley of death"*)	
Lack of capacity to produce new products at large scale for the market	
Delays in patent registration	

Thank you for your participation!

The following questions only pertain to respondents whose institutes have managed to commercialize at least one product in the past 12 – 24 months.

10. Which of the following new product categories have you managed to commercialize? **(You may indicate more than one category).*

Electronic gadgets	1
Agricultural inputs	2
Food items & Herbs	3

Farming implements	4
Building materials	5
Auto parts and accessories	6
Other *(specify)…*	7

11. What really drives you to develop and eventually commercialize new products?

Changes in technology	1
Availability of R & D staff	2
Our mandate	3
Market trends	4
Other *(specify)…*	5

12. How do you normally create market awareness of the new product(s)?

Newspaper advertisements	1
Through internal marketing	2
Internet	3
Through customer walk-ins	4
Through Launch campaigns & exhibitions	5
Other *(specify)…*	6

13. **Indicate by ticking the appropriate box, the extent to which you think the following factors could hinder the commercialization of technological innovations.**

	To a large extent	**To some extent**	**Not at all**
a. Absence of demand-pull approach in project selection	1	2	3
b. Search for technical excellence at the cost of commercial reality	1	2	3
c. Time lags in transfer / delays in bringing idea to market	1	2	3
d. Lack of sustained follow-ups	1	2	3
e. Failure of government to provide technology infrastructure	1	2	3
f. "R & D" biased funding	1	2	3
g. Unavailability of Resources	1	2	3
h. Low remuneration for research staff	1	2	3
i. Flaws in R & D managements functions	1	2	3
j. High product development costs	1	2	3
k. Strict patent laws	1	2	3

14. What other factors do you think could hinder the commercialization of technological innovations in the institute?

(a)……

(b)……

(c)……

(d)……

To what extent do you agree with each of the following statements? Please indicate you responses using 5-point scale where **1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Neutral (N), 4 = Agree (A) and 5 = Strongly Agree (SA).**

Statement	SD	D	N	A	SA
15. The market prefers local new products to imports.	1	2	3	4	5
16. The general public is aware of us and what we offer.	1	2	3	4	5
17. The public is aware of our location.	1	2	3	4	5
18. Our location is easily accessible to the market.	1	2	3	4	5
19. We have resources specifically committed to commercialization.	1	2	3	4	5
20. We educate the market about our new products on offer.	1	2	3	4	5
21. We train the market about technical issues of our new products.	1	2	3	4	5
22. We take our time test-marketing our technological innovations.	1	2	3	4	5
23. We have strong technological infrastructure.	1	2	3	4	5
24. The Zimbabwean market regulators protect our patents.	1	2	3	4	5
25. Information dissemination about our new products is adequate.	1	2	3	4	5
26. Government is giving adequate support for commercialization.	1	2	3	4	5
27. R & D staff is highly motivated.	1	2	3	4	5
28. Our marketing team is highly motivated.	1	2	3	4	5
29. We use feedback from the market.	1	2	3	4	5
30. Zimbabwe's economic situation supports new products' commercialization.	1	2	3	4	5
31. The public / private sector *(*delete the inapplicable)* is supportive in our commercialization efforts.	1	2	3	4	5

32. In your view what factors can promote the commercialization of technological innovations?

(a)……

(b)……

(c)……

33. How can commercialization of technological innovations be improved?

(a)……

(b)……

(c)……

34. Write any other information you want to communicate about commercialization of technological innovations generally in Zimbabwe.

……
……
……
……

Thank you for your participation.

Appendix 5: Research instrument 3 (Interview Guide)

UNIVERSITY OF KWAZULU-NATAL

School of Management, IT & Governance

Dear Respondent,

PhD Research Project

Researcher: Mr. Fanny Saruchera (+263 (0)772 436 775)

Supervisor: Dr. M.A. Phiri (+27(0)33-2605736)

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Determinants of Commercialization of Technological Innovations in Developing Economies: a Study of Zimbabwe's Research Institutes

The purpose of this survey is to solicit information from management regarding their thoughts on factors affecting the commercialization of technological innovations in Zimbabwe. From this interview, we hope to understand the role of Public-Private Partnerships (PPPs) in the commercialization of Zimbabwe's innovations. The results are intended to contribute to the development and revival of PPPs that will improve development and successful commercialization of Zimbabwe's technological innovations.

The information and ratings you provide us with will go a long way in helping us establish the current situation in a bid to come up with the way forward. The interview should only take 20-30 minutes to complete. In this interview, you are asked to indicate what is true for you, so there are no "right" or "wrong" answers to any question.

Thank you for participating!

INTERVIEW GUIDE

1. Do you know of any successful collaboration between any of Zimbabwe's private and public research institutes?
2. Does your institute have any strategic links with the private / public sector? How many of such partnerships do you have (if any)? And how are you related?
3. How aware do you think the general public is about the existence of these alliances?
4. How have such PPPs been operating in terms of role distribution? Funding / resource management?
5. How have such links helped you in R & D and commercialisation of your new products? / How do you think such links could be of help to you in R & D and commercialisation of your new products?
6. Why would you think we need more PPPs in Zimbabwe's attempts to market our technological innovations locally? Internationally?
7. What benefits do you perceive of PPPs in Zimbabwe?
8. What could be done to encourage development and enhancement of such partnerships?
9. What roles do you expect PPPs to play in new product commercialization?
10. How could such alliances be made more effective in their operations?
11. What lessons can we draw from any PPP success stories in Zimbabwe or elsewhere, in improving our technological innovations commercialization?
12. How could "best practices" for running PPPs be established?

Thank you for your participation

Appendix 6: Publications / Research Articles emerging from the Thesis and related themes (Select abstracts only)

Saruchera, Fanny, Phiri, Maxwell A., & Chitakunye, Pepukayi (2014). Consumer perceptions about E10 fuel in Zimbabwe: managerial implications. *Journal of Contemporary Management, 11*, 470 - 490.

Journal of Contemporary Management
Volume 11

Consumer perceptions about E10 fuel in Zimbabwe: managerial implications

F SARUCHERA (Chinhoyi University of Technology, Zimbabwe; University of Kwazulu-Natal, South Africa)
MA PHIRI (University of Kwazulu-Natal, South Africa)
P CHITAKUNYE (University of Witwatersrand, South Africa)

Abstract

This study contributes to an understanding of how consumer misinformation, leading to negative perceptions, can encourage the anti-consumption of some green products. Multiple methods were used to gather data, with the intention of bringing multiple points of view to the emerging misinformation surrounding the consumption of E10 fuel.

The market acceptance and uptake of Zimbabwe's E10 has remained pessimistic, yet elsewhere in the world, the same blend has been packaged as a 'premium, super brand'.

The study utilizes methodological triangulation to generate richer data, and deeper insights about the socially constructed meanings surrounding the commercialisation and consumption of blended fuel. The study uncovers a host of misinformation patterns and misconceptions ranging from technical issues concerning the fuel's composition, engine compatibility, mixed pricing views as well as policy-related issues. Revealing how blended fuels have succeeded elsewhere, the study shows how blended fuel misinformation can be handled through mandatory blending and market education on E10 economic benefits. The study's findings contribute to an understanding of how consumer misinformation spread through the market and in turn, how such misconceptions can negatively affect a product's image, sales and market share. Thus in managing these misconceptions, the study underpins the need for adequate consumer education and improving market access of E10 as the project has the potential for creating jobs, improving fuel supply in Africa, while upholding a green environment.

Key phrases

commercialisation; consumer misinformation; E10 fuel; perceptions; Zimbabwe

1. INTRODUCTION

Consumer researchers have explored the role of consumer misinformation, as well as socially and culturally constructed meanings of consumption (Brown, McDonough & Shultz 2013). Most of this work has drawn insights from consumers in well developed economies, who are often surrounded with an abundance of choice for consumer goods.

Appendix 7: Language Editing Confirmation

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Editing Confirmation

27/11/2014

Thesis title: Determinants of commercialization of technological innovations in developing economies: a study of Zimbabwe's research institutes

Author: Fanny Saruchera

This serves to confirm that the abovementioned thesis was edited by a member of the KwaZulu-Natal Language Institute's professional English language editing team. Various suggestions and corrections have been made. It is the responsibility of the author to implement and attend to these.

Ms G. Coertze
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