

A model for innovation leadership in South African companies

by

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Summary

The problem: Ideally, the underpinning principles and processes that innovation leaders practise in South African companies are well-established. In reality, however, the extent to which principles and processes are known and adapted to innovation leadership in the South African *means* and *social context* was found to be limited. Without this locally developed understanding, the processes and underpinning principles for leading innovation remains a “black box”, perpetuating innovation leaders’ struggle to advocate and execute innovation initiatives.

The method: Guided by the *means* and *social context* concepts identified by previous academic studies, this research questioned how successful innovation leaders in existing South African companies use the *means* of technology, market requirements and external resources. How these above *means* were integrated through processes of *learning* by experimentation from within their company’s *social context*. How from within the company’s social context the innovation leaders organised and planned innovation activities, selected and managed innovation team members, and maintained a positive working relationship between ongoing operations and innovation activities. These concepts informed the development of a conceptual framework and questions that were used to gather primary data during semi-structured interviews with South African innovation leaders using a multiple case study method. For this purpose, successfully commercialised innovations were identified, and the innovation leaders directly involved in these projects were interviewed to gather the primary data.

The findings: The research explains how South African innovation leaders were able to integrate their *means* and *social contexts*, cognitive abilities and supportive behaviour of their company to successfully develop innovation projects. The resulting model for innovation leadership in South Africa modified the existing First World model by describing and expanding the underpinning principles and internal/external *learning* processes that innovation leaders used to successfully commercialise innovations in the South African emerging socio-economic context.

Key terms: Innovation leader, innovation leadership model, innovation execution principles, organisational structure for innovation, planning for innovation, innovation team, innovation experiments, positive relationship between ongoing operations and innovation initiatives, internal and external processes for innovation, corporate entrepreneurship, technology, market requirements and external resource networks.

DECLARATION

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*"I declare that **A model for innovation leadership in South African companies** is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.*

I further declare that I submitted the thesis to originality checking software and that it falls within the accepted requirements for originality.

I further declare that I have not previously submitted this work, or part of it, for examination at UNISA for another qualification or at any other higher education institution."



26 FEBRUARY 2019

Signature CA Duff

Date

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List of acronyms

BU	Business unit
CAD	Computer-aided design
CAQDAS	Computer-Aided Qualitative Data Analysis Software
CD	Compact disc
CEO	Chief executive officer
DMI	Design Management Institute
EE	Emerging economy
II	Innovation initiatives
IP	Intellectual property
IPO	Initial public offering
ICT	Information and communication technology
IT	Information technology
NACI	National Advisory Council on Innovation
NDP	National Development Plan
NSI	National system of innovation
OECD	Organisation for Economic Cooperation and Development
OO	Ongoing operations of the company
R&D	Research and development
R, D & D	Research, design and development
SME	Small and medium enterprises
S&T	Science and technology
UNISA	University of South Africa

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Chapter 1: Introduction

1.1 Background

“Operational excellence generates your profits today. Innovation excellence will generate your profits tomorrow.” (Van Wulfen 2016: 1)

The ability to innovate is a phenomenon that allows humankind to constantly reinvent itself and the environment in which humans exist. The ability to reinvent ourselves and our environment is of significant importance to the business realm; as Van Wulfen (2016) points out, it provides new commercial opportunities that counteract competitors, business stagnation and the loss of profitability. The skills set required for innovation in the business realm includes the ability to create new knowledge, design new things with this knowledge, and sell designed outputs for profit. The innovation phenomenon in a business context is defined as:

“the multi-stage process whereby organisations transform ideas into new/improved products, services or processes, in order to advance, compete and differentiate themselves successfully in their marketplace.” (Baregheh, Rowley and Sambrook 2009: 1334)

Humans are central to the innovation phenomenon, the complex ever-changing human condition that constantly affects and adapts the meaning and our understanding of innovation. This fluid meaning of innovation requires ongoing attention from the academic research community in order to constantly alter and update our understanding of this complex phenomenon as humankind continues to reinvent itself. Within the study field of innovation, there are many topics that attract the attention of academic researchers; one such topic is leading innovation activities in existing companies. Leaders of innovation initiatives play a vital role in moving innovative ideas forward through a process of execution in order to extract commercial advantage.

In 2010, Vijay Govindarajan and Chris Trimble completed a decade-long study of predominantly North American companies with the objective of understanding the common activities that the leaders of successful innovation projects used to execute these projects. They argued that coming up with new ideas was easy and that companies, in general, excel at proposing new ideas and solutions. What they argue was lacking and far more difficult to achieve was how to execute new ideas and turn them into new commercial opportunities ready for exploitation by the company. Their research led to the presentation of five common execution principles that successful leaders of

innovation projects practise. Govindarajan and Trimble (2010) found that successful innovation leaders execute innovation projects by repeatedly using *(i) organisational structure, (ii) planning, (iii) innovation team composition, the (iv) management of experiments and (v) maintaining a positive working relationship between ongoing operations and innovation activities*. They found that these principles significantly improve the chances of success of new innovative ideas. They argued that these five principles are valid regardless of the size of the company, the context in which it operates and the nature of the innovation project.

Initially, Govindarajan and Trimble (2010) determined that the complexity of innovation initiatives within established companies could be described as either routine innovation or difficult innovation. They acknowledged that companies in North America and their innovation leaders were competent in achieving routine innovation. The focus of their 10-year longitudinal study was to better understand “difficult innovation initiatives”. Developing theoretical principles that would aid the practice of these so-called “difficult innovation initiatives” (Govindarajan and Trimble 2010: 5). In essence Govindarajan and Trimble (2010) found that innovation leaders working for established companies in the First World socio-economic context have proved their capability to deliver successful routine innovations. Govindarajan and Trimble (2010: 6-7) described routine models of innovation as either innovation = idea + process, or innovation = idea + motivation.

Academics who have studied the innovation in the context of South Africa argue that little is known about the company-level routines and processes that drive innovation (Lorentzen 2009; Booyens 2011). Booyens (2011) argued that company-level business skills development that included creative thinking and problem-solving was required to encourage innovation in the South African emerging socio-economic context. The work of numerous academics, including Lorentzen (2009) and Booyens (2011), implies that unlike the First World socio-economic context where routine innovations are understood and implemented, and the principles for difficult innovations are beginning to be successfully implemented, South African companies are not proficient at routine or difficult innovation initiatives. This notion is supported by the findings of Grobler and Singh (2018) who found that leaders of organisations in Southern Africa do not focus on fostering innovation behaviour in their organisation. They are of the opinion that the concern of leaders is on the status quo, instead of striving for constant renewal and innovation.

This doctoral thesis uses principles that originate from difficult innovation, as described by Govindarajan and Trimble (2010), to investigate how they apply to the South African emerging socio-economic context and what modifications might be necessary to adapt

these First World economy innovation execution principles. These principles, which have been proved to be effective through the results of the longitudinal study by Govindarajan and Trimble (2010), do, however, lack an explicit means of directly dealing with forces and influences that are external to the organisation. Academic researchers such as Porter (1979), Rothwell (1994), Osterwalder, Pigneur and Tucci (2005), Teece (2010) and Chesbrough (2010, 2012) argue that external forces play a significant role in the successful exploitation of newly developed innovations.

Innovation in South African companies is described by Lorentzen (2009: 33) as the “black box” of innovation. He implies that nothing is known about the organisational routines, processes and drivers of innovation in South African companies. This lack of local understanding significantly affects the willingness and ability of South African companies to innovate in a regular and successful manner. Recent research by Urban and Wood (2017: 552) developed what they called an “introductory roadmap” of innovation in established South African companies. They suggested that their study might be used to guide future research and theory development (Urban and Wood 2017). Urban and Wood (2017) demonstrated the correlation between (i) *South African companies support* of (ii) *entrepreneurial individual staff members* that resulted in (iii) *entrepreneurial activity* at these companies. They confirmed that organisational support had a positive correlation with the entrepreneurial alertness and metacognitive abilities of individual staff members, leading to entrepreneurial activity resulting in new product, service and process innovations (Urban and Wood 2017). Using these findings as a theoretical basis, Urban and Wood (2017) called for further research that investigated the interaction between contextual, cognitive and behavioural concepts for individuals within established South African companies. The present research focuses in particular on the contextual, cognitive and behavioural concepts for innovation leaders in established South African companies.

1.2 Research problem

Problem statement: Ideally, the underpinning principles and processes that innovation leaders practise in South African companies are well-established. In reality, however, the extent to which these principles and processes are known and adapted to the South African *means* and *social context* was found to be limited. Without this locally developed understanding, the processes and underpinning principles for leading innovation remains a “black box”, perpetuating innovation leaders’ struggle to advocate and execute innovation initiatives.

Ideally, the execution of innovation initiatives with the available *means* within the *social context* rewards companies that take calculated risks with successful innovative outcomes that contribute to their competitive advantage and sustainability. Repeated successful outcomes for innovation projects rely in part on a foundation of repeatable processes underpinned by principles that the leaders of such projects can apply to a range of different innovation projects; hence the development of common principles that innovation leaders can use to execute new projects. Common underpinning principles and processes are useful in several ways. Firstly, being common implies that these underpinning principles and processes are applicable to any innovation initiative regardless of the company or the type of solution being developed (Lorentzen 2009; Govindarajan and Trimble 2010). Secondly, the scientific process followed by academic research provides proof of the necessity and validity of the identified underpinning principles and processes (Lorentzen 2009; Govindarajan and Trimble 2010; Urban and Wood 2017). Thirdly, making these underpinning principles and processes known guides the work of innovation leaders, helping them to avoid spending time and resources on fruitless activities that do not contribute to the success of the innovation project (Lorentzen 2009; Govindarajan and Trimble 2010; Urban and Wood 2017). Fourthly, making these underpinning principles and processes known helps senior managers to understand and monitor the innovation process effectively (Lorentzen 2009; Urban and Wood 2017; Grobler and Singh 2018). In effect, common underpinning principles and processes for the leadership of innovation projects provide a repeatable and reliable game plan that increases the chances of commercial success for innovation projects.

The actual situation is that there is no local research investigating how innovation leaders execute the established common principles and processes in South African companies (Rooks and Oerlemans 2005; Lorentzen 2009; Vlok 2012; Urban and Wood 2017). The local innovation community relies on research from other parts of the world without local rigorous scientific investigation to confirm or dispute their validity. This international research provides a starting point to pose questions about the “black box of innovation” in South African businesses. The actual situation is also exacerbated by the lack of innovation driven behaviour of Southern African leaders as discovered by Grobler and Singh (2018) when comparing them to the innovation intensive behaviour of North American leaders.

Without a local scientifically rigorous investigation of how innovation leaders practice innovation within the local *means* and *social context* it is not possible to determine what underpinning principles and processes apply to innovation leadership in South African companies. Without an understanding of the innovation leadership role the “black box of

innovation” with regards to innovation leadership for South African companies remains closed (Lorentzen 2009: 33). (Rooks and Oerlemans 2005; Blankley and Moses 2009; Lorentzen 2009) maintain the costs of not investigating company level drivers of innovation inside South African companies include:

- A lack of understanding of how local innovation leaders differ from established First World innovation leaders (McFadzean, O’Loughlin and Shaw 2005; Govindarajan and Trimble 2010).
- Existing underpinning principles and processes of innovation leadership cannot be confirmed, disputed, adjusted or extended to better fit the local South African context (McFadzean et al. 2005; Govindarajan and Trimble 2010)
- Local innovation leaders and senior management remain uninformed about adaptations to the common underpinning principles and processes that could lead to successful innovation leadership to better fit the local South African context (Urban and Wood 2017; Grobler and Singh 2018).

Furthermore the cost of not investigating the “black box of innovation” and modifying the existing underpinning principles and processes for the local *means* and *social context* implies that South African companies will continue to be ill-prepared to make use of the advantages that innovation offers (Urban and Wood 2017; Grobler and Singh 2018). Innovation has the potential to overcome traditional and contemporary barriers of entry to local and global markets (Blankley and Moses 2009). This potential advantage gives companies the ability to circumvent external forces and barriers that might otherwise be insurmountable (Booyens 2011). Innovation provides a competitive edge that is difficult to counteract, providing space for local companies to successfully compete (Dustin, Bharat and Jitendra 2014).

1.3 Research questions

How do successful innovation leaders in existing South African companies use the *means* at their disposal to *learn* from within their company’s *social context* to execute successful innovation projects?

The nine questions integrated with the main research question are:

1.3.1 How do the innovation leaders’ technology learning engagements with their *social context* contribute to innovation projects?

1.3.2 How do the innovation leaders’ market requirements learning engagements with their *social context* contribute to innovation projects?

1.3.3 How do the innovation leaders' external resource network learning engagements with their *social context* contribute to innovation projects?

1.3.4 How do the innovation leaders' external experiments with technology, market requirements and resource networks from their *social context* integrate with innovation projects?

1.3.5 How do disciplined internal experiments orchestrated by the innovation leaders contribute to new solutions?

1.3.6 How do organisational structures used by innovation leaders move innovation activities forward?

1.3.7 How does the innovation leaders' planning, informed by organisational learning, guide the innovation process?

1.3.8 How do the innovation leaders' selection and management of innovation team members provide a suitable mix of competencies to drive innovation?

1.3.9 How do the innovation leaders maintain a positive working relationship between ongoing operations and innovation initiatives?

1.4 Research purpose

The purpose of the study was to uncover how external and internal *learning* processes underpinned by existing principles, informed by the *means* and *social context* attributes from Baregheh et al. (2009) definition of innovation are practised by successful innovation leaders in South African companies. In so doing, the study aimed to develop a model to describe the processes and underpinning principles that innovation leaders used to successfully commercialise innovations in South African companies, thereby confirming and / or modifying the First World model of Govindarajan and Trimble (2010), which does not account for external processes and principles, to better fit local emerging socio-economic conditions. The purpose of the study was achieved by investigating the following research sub-purposes:

Research Sub-Purpose One: To determine how innovation leaders' used technology as a *means* in their local *social context* to create successful innovation initiatives, thereby determining the contribution of the technology *means* to the model for innovation leadership in South African companies.

Research Sub-Purpose Two: To determine how innovation leaders' established market requirements as a *means* in their local *social context* to create successful innovation

initiatives, thereby determining the contribution of the market requirements *means* to the model for innovation leadership in South African companies.

Research Sub-Purpose Three: To determine how innovation leaders' used their external resource network as a *means* in their local *social context* to create successful innovation initiatives, thereby determining the contribution of the external resource network *means* to the model for innovation leadership in South African companies.

Research Sub-Purpose Four: To determine how innovation leaders' integrated external technology, market requirements and external resource networks *means* in their local *social context* through a process of experimentation, thereby developing an understanding of how experimentation contributes to the model for innovation leadership in South African companies.

Research Sub-Purpose Five: To determine whether innovation leaders' used disciplined unbiased cause-and-effect experiments in their *social context*, thereby confirming or disputing whether internal disciplined cause-and-effect experiments contribute to the model for innovation leadership in South African companies.

Research Sub-Purpose Six: To determine whether innovation leaders' used explorative organisational structures allowing them and their assigned personnel and resources to explore new ideas in their *social context*, thereby confirming or disputing whether ambidextrous organisational structures contribute to the model for innovation leadership in South African companies.

Research Sub-Purpose Seven: To determine whether organisational learning linked to internal and external engagements of the innovation leader is an appropriate planning strategy for innovation initiatives in their *social context*, thereby confirming or disputing whether planning using a combination of internal and external learning contributes to the model for innovation leadership in South African companies.

Research Sub-Purpose Eight: To determine whether the selection and management of innovation team members used by the innovation leader follow Govindarajan and Trimble's (2010) model of team composition in their *social context*, thereby confirming or disputing the applicability of their model of team composition to the model for innovation leadership in South African companies.

Research Sub-Purpose Nine: To determine whether the positive working relationship between ongoing operations and innovation initiatives is maintained by innovation leaders who practised the principles of the conceptual framework in their *social context*, thereby

confirming or disputing whether the innovation leaders' effective execution of the underpinning principles of the conceptual framework gains support from the ongoing operations of South African companies, and determining the contribution of the positive working relationship to the model for innovation leadership in South African companies.

In light of the above problem statement and research sub-purposes, the thesis statement of this study is:

The underpinning principles and processes applied by innovation leaders who successfully commercialise innovation initiatives in South African companies are not fully described by the First World model of internal innovation execution, since these principles and processes fail to account for the combination of *social context*, *means* and internal and external *learning* practised by South African innovation leaders.

This thesis statement argues that the significant differences between the socio-economic context of First World countries in which these underpinning principles and processes were developed and the emerging socio-economic nature of South Africa have not been understood since the First World model focused only on internal principles and processes. In the context of this study the term "significant differences" described how the emerging economic context of nations such as South Africa (Bruton, Filatotchev, Si and Wright 2013) differ significantly to "First World" nations (Govindarajan and Trimble 2012). Socio-economic contextual differences are likely to manifest both internally in South African companies and externally in the South African business environment. The thesis statement above succinctly captures the intent of the problem statement and research purposes to investigate these existing principles in a new environment (South Africa) along with the additional contextual concepts of external technology, market requirements, resource networks and the integration of these external learning processes with the company. Juxtaposing these principles and concepts against innovation leaders' practices in South African companies is intended to demystify the processes and underpinning principles of innovation leadership in these companies. The "thesis statement" device put forth by Hofstee (2006) has been used as it helped to precisely define what the study intended to investigate. Naming and delineating the problem the study planned to investigate thereby helping devise a method of investigation. The thesis statement allowed the study to take a stance about the untested assumptions it posed. Preventing the thesis from becoming unfocused and providing the study with a contract or promise to the reading audience about the new knowledge that would be presented in the findings.

1.5 Delineation and limitations

This research considered only the concepts identified in the research questions above drawn from the literature review and conceptual framework. The concepts stemmed from the work of Rothwell (1994), McFadzean et al. (2005), Baregheh et al. (2009), Lorentzen (2009), Govindarajan and Trimble (2010), Chesbrough (2010, 2012 & 2017), Booyens (2011), Bruton et al. (2013) and Urban and Wood (2017). This literature informed the development of questions used to gather primary data during semi-structured interviews with South African innovation leaders. Therefore, the scope of this study was limited to the investigation of the principles and concepts presented in the conceptual framework and did not consider any other principles, concepts or points of view that might influence practising innovation leaders. This study acknowledges that limiting the scope of investigation implies that the findings have inherent limitations. However, the principles and concepts used in this research have in previous studies proved to be significant findings in themselves by demonstrating their generalisability in First World companies.

- The study only investigated companies that originated in South Africa for the following two reasons. Firstly, this ensured better access to the actual innovation leaders who had successfully brought new innovations to the market. Gaining access to innovation leaders in companies that originated in other countries would require a significantly larger budget to travel to the country of origin, as international companies might not place their innovation leaders in South Africa. Secondly, the study intended to make a contribution to the understanding of innovation leaders in South African companies; hence gathering primary data from innovation leaders based at international companies would significantly weaken the relevance of the results to the South African context. The data and analytical generalisation are intended to be relevant primarily to the South African business context, and might be less relevant to other business contexts.
- This study was intended to contribute to the comprehensive innovation policy framework named South Africa's National Innovation Framework developed by the South African National Advisory Council on Innovation (NACI), and in particular to policy framework area number eight (commercialisation of know-how) related to innovation leaders situated in established businesses playing a critical role in the commercialisation of know-how or new ideas.
- This study only investigated successful product and service innovations, not process innovations. Process innovation is difficult to quantify and is often securely guarded by the company as there is no need to disclose this type of innovation, in contrast to product and service innovation, which exist in the public domain.

- This study focused only on individual innovation leaders and small groups of innovation leaders working together that had been identified as having previously brought innovative ideas to market successfully.
- This study did not focus on leadership styles. Leadership theory and styles are acknowledged to be important and have received attention in the literature; this is covered briefly in the literature review. However, this research does not contribute to that field of study.
- This study was delimited to the observation of innovation leaders inside South African companies and was further limited by time and cost constraints. The research therefore comprised seven case studies.

1.6 Significance

This study intended to make several theoretical and practical contributions. The theoretical significance of this study was to explain the following:

- To explain how South African innovation leaders made use of internal and external *means* and *social contexts* to develop successful product and service innovations.
- To explain how South African innovation leaders made use of their cognitive abilities through disciplined experiments to develop successful product and service innovations.
- To explain how the behaviour of South African innovation leaders maintained a positive outlook for innovation projects within their companies context enabling them to develop successful product and service innovations.

The practical significance of this study was the development of a model based on the findings from the data. The model for innovation leadership in South African companies was intended to benefit individuals and organisations, including academic researchers who study innovation leadership, practising innovation leaders and their business organisations, educators involved in teaching innovation leadership skills and local policymakers who contribute to the development and implementation of local innovation policy. In particular:

- Academic researchers might benefit from the model, as no South African model has been developed before to explain the practice of South African innovation. This new model, built on existing research, provides researchers with new opportunities to confirm or dispute the model.
- Practising innovation leaders might benefit from this research by using it to guide their practices and help them avoid pitfalls by maintaining alignment with the best practices

presented in the model, thereby building robust innovation processes in their companies.

- Educators might benefit from this model by using it to guide the development and delivery of training curricula for innovation leadership skills development.
- Policymakers might benefit from this model by using it to inform the development of policy aimed at guiding the commercialisation of “know how” listed as part of the eight areas of policy framework development by NACI.

1.7 Research objective

The research objectives were informed by the selected research design and the chosen methodology that resulted from the research design classification (Babbie and Mouton 2007). The discussion and justification for the chosen research design (Babbie and Mouton 2007), the chosen methodology (Yin 2014) and conceptual framework (Yin 2014) described in section 2.6 are discussed in detail in chapter 3 Research design and methodology. The following steps were taken to achieve the stated purposes of the study:

- Conducting a literature review on innovation leadership informed by the principles identified as common to the leadership of all innovation projects (Govindarajan and Trimble 2010), and identifying the challenges that exist for innovation in the South African context.
- Designing a multiple case study method to investigate local innovation leaders at their places of work. The design included the development of a conceptual framework, research questions, theoretical propositions derived from the questions, the units of analysis, the logic linking the data to the theoretical proposition, and the criteria for interpreting the findings (Yin 2014).
- Developing a case study protocol that included an overview of the case study, data collection procedures, data collection questions and a guide for the case study report (Yin 2014).
- Obtaining methodological and ethical approval based on the case study protocol document in order to continue with the study. Provided by UNISA Graduate School of Business Leadership’s Research Ethics Review Committee.
- Collecting and interpreting the data as agreed by the case study protocol document (Yin 2014).

- Presenting the findings of the research questions and the new model of innovation leadership in South African companies (Hofstee 2006; Babbie and Mouton 2007; Yin 2014).

1.8 Assumptions

This study assumed that the concepts extracted from the work of Rothwell (1994), McFadzean et al. (2005), Baregheh et al. (2009), Lorentzen (2009), Govindarajan and Trimble (2010), Chesbrough (2010, 2012 & 2017), Booyens (2011), Bruton et al. (2013), Urban and Wood (2017) and Grobler and Singh (2018) are applicable at least in some ways to the innovation context of existing South African companies in terms of:

- External *means* of innovation (technology market requirements and resource networks) (Baregheh et al. 2009; Booyens 2011; Chesbrough 2010, 2012 & 2017; Bruton et al. 2013).
- Integration of internal and external *social contexts* (Rothwell 1994; Booyens 2011; Chesbrough 2012; Bruton et al. 2013).
- Disciplined experimentation (Govindarajan and Trimble 2010).
- Organisational structure of innovation (Govindarajan and Trimble 2010).
- Planning innovation activities (Govindarajan and Trimble 2010).
- Composition and management of the innovation team (Govindarajan and Trimble 2010).
- Maintaining a positive relationship between ongoing operations and innovation activities (Govindarajan and Trimble 2010).
- The study assumed that the manifestation of these concepts in South Africa companies might contribute to the development of a model to help describe and explain the role of effective innovation leadership in South African companies (McFadzean et al. 2005; Lorentzen 2009; Booyens 2011; Urban and Wood 2017; Grobler and Singh 2018).
- This study considers that there is significant overlap in meaning between the concepts of “entrepreneurial” and “innovative” activity at companies, and these concepts have been used interchangeably in this research project. Corporate entrepreneurs are understood to be innovative individuals in established companies, and these individuals may be innovation team members or innovation leaders (Urban and Wood 2017).

1.9 Clarification of key terms

The clarification of key words and terms is provided to give a clear and consistent meaning for the use of these words and terms throughout this study.

Ideally	Implied that an ideal way to apply innovation principles and processes existed for each company and that this ideal application was unique to each company's capabilities and contexts and that there was no singular ideal way to apply these principles and processes across companies.
Black box	Implied that a gap in understanding for the principles and processes applied by successful South African innovation leaders existed. In other studies (Lorontzen 2009: 33) the term "Black Box" is applied to a broader range of gaps in understanding of how innovation occurs in South African companies.
Repeatable processes	Described the process of experimentation (Govindarajan and Trimble 2010) and how successful innovation leaders used the process of experimentation to synthesise and learn for the purpose of driving innovation forward to successful outcomes.
Common principles	Described common principles innovation leaders in North America successfully used to execute innovation initiatives. These principles resulted from a 10 year longitudinal grounded theory case study research conducted by (Govindarajan and Trimble 2010).
Underpinning principles	Described both existing common principles as put forth by (Govindarajan and Trimble 2010) and any other principles not yet explained by research of innovation leaders practice in South African companies. These included internal and external principles and the observed application of repeatable process of experimentation.
First world	Described the technologically advanced context of nations that led academic and scientific exploration and were well resourced to undertake these research and development activities. These first world nations differed from South Africa which was described as an emerging nation in which significant limitations on academic, scientific exploration and recourse availability were observed.
Leader/s	Described individuals or small groups of individuals who worked together to lead innovation projects within their company.
Leadership	Collectively described people who lead innovation projects in a business context.

Successful Innovation leaders	Described the individuals and small groups of individuals who were the unit of analysis for this study.
Companies	Described private sector companies who operated for commercial gain. The following companies were not included in the meaning of the word companies for this study; Universities, Science Councils and Public Sector organisations.

Table 1: Clarification of key terms

1.10 Overview of chapters

Chapter 1 provides an introduction and overview of this research project. Chapter 2 reviews the literature dealing initially with innovation research from a global perspective and then from a South African perspective, which collectively lead to the focus of this study. Chapter 3 describes the research design and methodology used to investigate the phenomenon of innovation leaders in existing South African companies. Chapter 4 presents the data analysis process in a question-and-answer mode, followed by a cross-case analysis. Chapter 5 discusses and interprets the data analysis to determine how the model of innovation leadership differs in the South African context. Chapter 6 presents the conclusions from the findings, the model for innovation leadership in South African companies, the knowledge and practical contributions, and recommendations for further research.

Chapter 2: Literature review

The literature review covers scholarly works that contribute to understanding the role that leadership plays in innovation projects in a business setting. The literature informs this research of existing theories, models and practices used for the leadership of innovation activity in businesses globally.

The literature review is divided into six sections. Section 2.1 presents the theoretical basis of innovation in a business context. Section 2.2 discusses key aspects of innovation in a business context. Section 2.3 presents the status of innovation in South African businesses. Section 2.4 discusses the innovation process and the role of innovation leaders, and how these two concepts are combined in a business context. Section 2.5 draws on the previous four sections to summarise the challenges that innovation leaders face in executing innovation in existing companies. Section 2.6 concludes the literature review by presenting the conceptual framework that will be used to investigate South African innovation leaders in established companies.

2.1 Theoretical basis of innovation

This section begins by providing a multidisciplinary definition of innovation in subsection 2.1.1, presents theoretical approaches to innovation research in subsection 2.1.2, and provides an analysis of the focus areas of innovation research based on the multidisciplinary definition in subsection 2.1.3. As a whole, section 2.1 sets out to provide a common understanding of the study of innovation within the field of business. Identifying commonalities uncovers which contemporary issues related to innovation are attracting attention from the research community.

2.1.1 Innovation definition

The multidisciplinary definition of innovation set out below in text and diagrammatic formats (Figure 1) provides a succinct summary of 60 definitions of innovation drawn from the following seven distinct business disciplines: 1) business and management, 2) economics, 3) organisational studies, 4) innovation and entrepreneurship, 5) technology, science and engineering, 6) knowledge management and 7) marketing.

“Innovation is the multi-stage process whereby organisations transform ideas into new/improved products, services or processes, in order to advance, compete and differentiate themselves successfully in their marketplace.” (Baregheh et al. 2009: 1334)

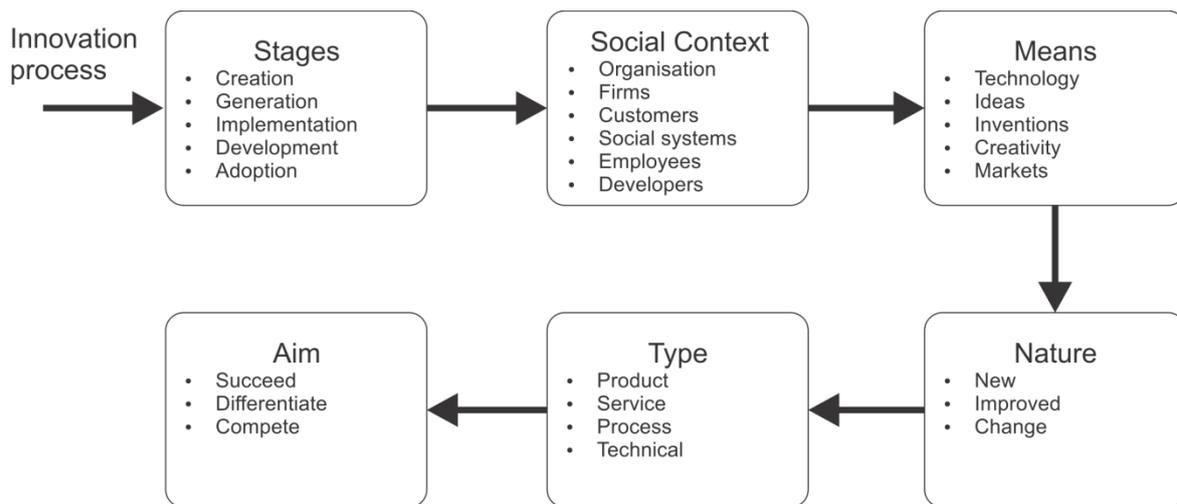


Figure 1: Multidisciplinary definition of innovation (Baregheh et al. 2009: 1333)

Baregheh et al. (2009), who suggested the multidisciplinary definition of innovation, argue that the process of innovation is generalisable and can be applied to any business context and discipline. The fact that the six attributes identified in this multidisciplinary definition can be applied to all business disciplines is important, as it provides a common understanding and language for innovation across disciplinary boundaries. This common understanding of innovation can be applied to the leadership of innovation initiatives. Providing innovation leaders with a common framework and language for the process of innovation enables a common understanding and meaning to emerge. The attributes common to all innovations regardless of discipline are:

- Stages of innovation: describes the steps in the innovation process
- *Social context* of innovation: describes the social entity and environmental factors that influence innovation
- *Means* of innovation: describes the resources required for innovation to occur
- Nature of innovation: determines whether an innovative change is new or an improvement
- Type of innovation: describes the innovation output (e.g. product, service, process or technical)
- Aim of innovation: describes the result that the firm wants to achieve from innovation.

Three of the attributes, namely stages, type and aim, are easy to understand and have a stable meaning. *Social context*, *means* and nature require more in-depth discussion to uncover the range of meaning that is implied by these headings. The nature attribute is discussed below, while the *social context* and *means* attributes are discussed in subsection 2.1.3.

The nature attribute of the multidisciplinary innovation definition differentiates new innovation from improved innovation and change innovation (Baregheh et al. 2009). The discussion below focuses on the differences between improved and new innovation while change innovation is not discussed as this particular nature attribute is not included in this study. Improved innovation requires some development of an existing product, service or process. New innovation requires the introduction of something new (product, service or process), whereas the focus of improved innovation is on optimising existing products, services, processes or business models. Improving efficiency introduces innovation that can prolong the life and profitability of a product, service, process or business model, usually with minimal investment of resources (Christensen, Raynor and McDonald 2015).

New innovation can be further divided into two important groupings from a business perspective, namely continuous innovation and discontinuous innovation. Continuous or incremental innovation occurs where new products, services, processes or business models are developed based on their predecessors or existing markets (Morris 2013), and it allows a business to stay abreast of its competitors by offering competing solutions to customers. Discontinuous or disruptive innovation is where a business offers a completely new product, service, process or business model for which there are no competitors or existing markets, and the company is pioneering a never-before-seen product, service, process or business model (Morris 2013).

Each type of innovation has a different profit potential and lifespan (Figure 2). Profit potential and risk are the lowest for improvement innovation, increase for continuous innovation and are highest for discontinuous innovation. The lifespan is shortest for improvement innovation and longest for discontinuous innovation. This implies that more regular investment in improvement innovation is required to reinvigorate profit, while discontinuous innovation is likely to survive with the longest intervals between investments.

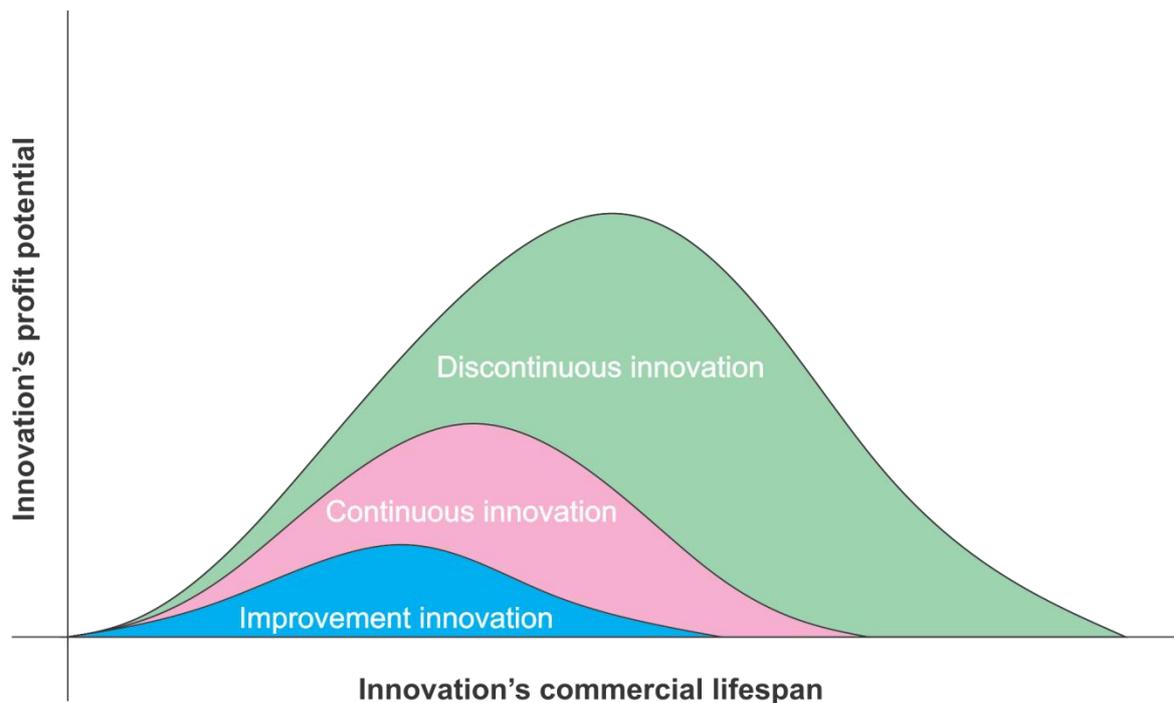


Figure 2: Nature of innovation Source: Author

The difference between continuous innovation and discontinuous innovation requires a deeper understanding. Continuous innovation is more closely linked to the activities of established businesses and the requirement for organisational learning (Linton and Walsh 2013; Moustaghfir and Schiuma 2013; Wei, Yi and Guo 2014; Denning 2015).

Discontinuous innovation is disruptive and alien to established businesses, and less likely to be linked to organisational learning (Linton and Walsh 2013; Moustaghfir and Schiuma 2013; Wei et al. 2014). Continuous innovation is far more prevalent than discontinuous innovation. Continuous innovation is accessible to most organisations that are sufficiently motivated to achieve innovation, whereas discontinuous innovation is rare, the preserve of a small minority of companies and individuals willing to risk everything. In the case of discontinuous innovation, failure is usually catastrophic, and success is meteoric. Both continuous and discontinuous innovations are important and necessary; however, the natural balance is heavily weighted in favour of continuous innovation (Linton and Walsh 2013; Moustaghfir and Schiuma 2013; Wei et al. 2014). This implies that innovation leaders who gain experience and understanding of how continuous innovation operates in a business context are generally more useful to the bulk of businesses than those who know how to succeed at discontinuous innovation.

Innovation in a business context might manifest itself either in an existing business or as a new business. Innovation in an existing business differs from innovation at the start of a new business in several ways:

- Innovation in existing businesses relies on organisational learning and is more likely to be a combination of improvements that lead to improvement and continuous innovation linked to previous products, services or processes of the company.
- Innovations that create new start-up businesses or are a spin-off business from an established firm have limited ties, or no ties, to prior organisational learning and culture. These new businesses are usually established to pursue a new continuous innovation or a discontinuous innovation. New businesses initially do not experience significant conflict between innovation activities and ongoing operations, as both activities are focused on commercialising the same innovation.

2.1.2 Approaches to innovation research

Two distinct theoretical perspectives are evident in innovation research, namely diffusion theory and the resource-based view (Harmancioglu, Droge and Calantone 2009). The two theoretical perspectives for innovation research attempt to answer innovation questions from different points of view. Diffusion theory places emphasis on the role of the user's perception of the acceptance of innovation. The resource-based view considers internal and external factors that influence the business organisation activities and competitive actions. Diffusion theory focuses on human behaviour, while the resource-based view focuses on organisational responses to market challenges.

The diffusion of innovation theory investigates the *means* by which innovation is dispersed through a society (Rogers 1962; Lundblad 2003). Studies of the diffusion of innovation attempt to explain:

- The process followed to adopt innovation
- The rate at which new innovations are adopted
- The reasons why an innovation has been adopted.

The five key elements of diffusion research are innovation, adopters, communication, time and social system (Lundblad 2003). The diffusion of innovation is measured over time, and the choice to adopt a new innovation over time is measured by a five-stage decision-making process developed for diffusion theory comprising knowledge, persuasion, decision, implementation and confirmation.

The resource-based view attempts to understand the basket of material and immaterial resources that a company uses to create and maintain competitive advantage and/or

competitive survival strategies (Harmancioglu et al. 2009). The five key measurements of company resources as posed by Harmancioglu et al. (2009) are:

- How valuable is the resource?
- How rare is the resource?
- How easily can it be imitated?
- To what extent can it be substituted?
- How ready is the organisation to take advantage of opportunities?

An important refinement of the resource-based view has been differentiating tangible tradeable resources non-specific to the company from capabilities that are not easily tradeable, are specific to the company and are used to engage resources within the company. Capabilities embedded in the personnel of the company are said to be dynamic capabilities that exist in a complex mix of changing market constraints and opportunities. Dynamic capabilities are viewed as being essential for competitive survival. Dynamic capability theory investigates how senior managers adapt to change and how companies develop and maintain dynamic capabilities to ensure competitive survival (Harmancioglu et al. 2009).

In an attempt to clearly define and understand the theoretical approach that underpins an academic study of innovation, two additional dimensions need to be added to either diffusion theory or the resource-based view, namely the level of analysis dimension and the perspective dimension. Analysis could be conducted at the project level (single innovation), or at the programme, firm or separate business unit level (multiple innovations). The perspective dimension considers the perspective from which the academic research is conducted, whether from the customer perspective, the firm perspective, or from both the customer and firm perspectives (Harmancioglu et al. 2009). Figure 3 below describes the three dimensions that are used to define an academic study of innovation.

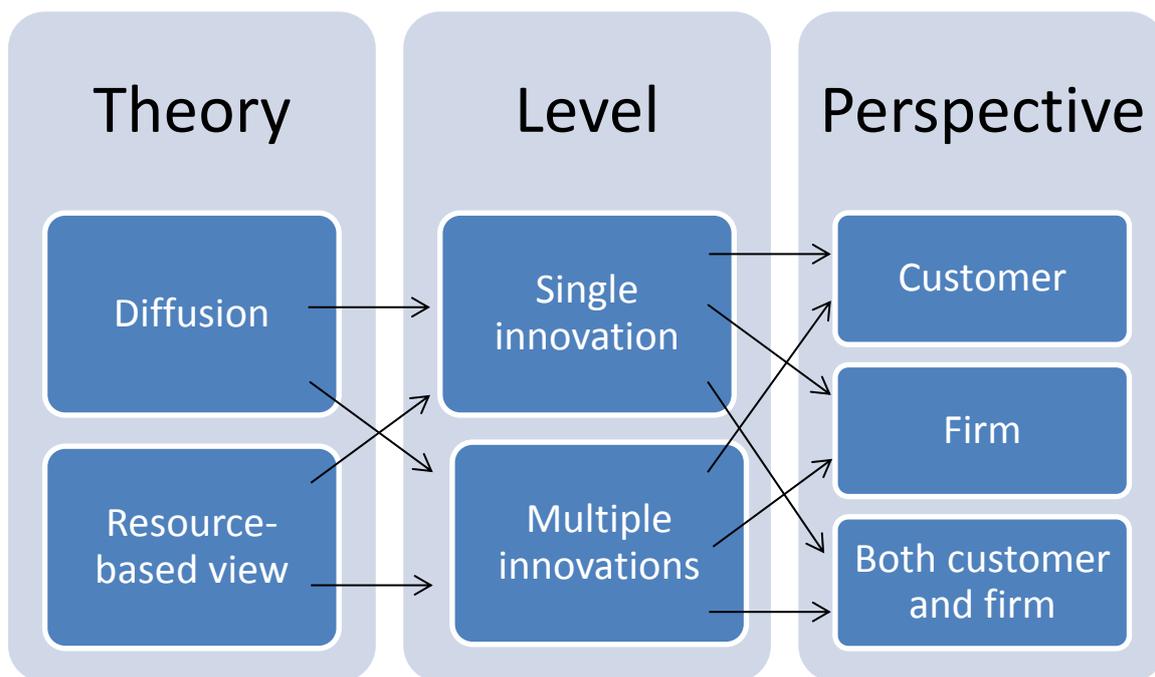


Figure 3: Dimensions of academic study of innovation (Harmancioglu et al. 2009: 236-237)

Defining the theoretical standpoint of the research in relation to all three dimensions contributes to its robustness. Describing the three dimensions explains to the audience the theoretical standpoint of the study, the level and the perspective that the academic investigation is taking. This three-dimensional description helps to explain the approach taken to investigate the phenomenon of innovation leadership, which in turn informs the appropriate research methodology (Harmancioglu et al. 2009). This study uses the resource-based view theory at the single innovation project level from the firm's perspective.

2.1.3 Focus areas for innovation research

A sample of 59 empirical studies on the topic of innovation in business was analysed using the multidisciplinary definition of innovation. Appendix 1 provides the index numbers, title, date and authors of the studies. The studies are a combination of peer-reviewed academic articles, master's dissertations and doctoral theses from multiple fields of business management, strategy, organisational studies, education and design.

The method of analysis was to categorise the studies according to the six attributes provided by the multidisciplinary definition of innovation. The academic studies are placed under the attribute/s that best describe the focus of the work. Table 2 and Figure 4 below show the results of the categorisation conducted.

Stages	Social context	Means	Nature	Type	Aim
75, 74, 257, 253, 255, 258	5, 14, 24, 27, 29, 38, 39, 55, 58, 65, 79, 81, 83, 87, 97, 100, 101, 102, 103, 104, 108, 111, 112, 113, 114, 123, 124, 125, 132, 136, 138, 153, 163, 165, 170, 175, 176, 177, 180, 186, 192, 208, 210, 228, 236, 238, 242, 249, 253, 255	5, 11, 21, 24, 27, 38, 39, 55, 76, 79, 83, 101, 108, 113, 114, 123, 124, 132, 136, 175, 208, 210, 236	52	21	123, 124, 132, 100, 101, 224, 236
Total 6	Total 50	Total 23	Total 1	Total 1	Total 7

Table 2: Categorisation of empirical studies on innovation

Percentage of empirical studies dealing with the six attributes of innovation

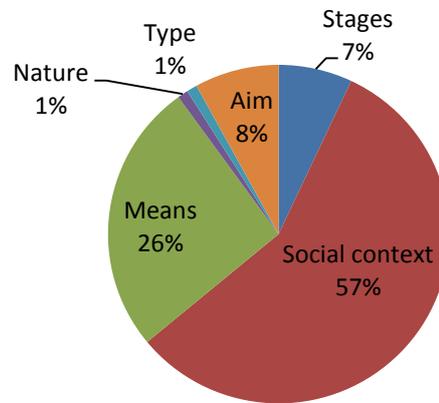


Figure 4: Pie chart of empirical innovation studies

The results of the analysis show that the bulk of academic research on innovation focuses on issues pertaining to the *social context* (57%) and *means* (26%) attributes of innovation across various business disciplines. The need to investigate the four remaining attributes of stages, nature, type and aim seem to be limited. This is probably because the stages of innovation, nature of innovation, types of innovation and aim of innovation are well defined and easily understood. These four attributes are each a stable construct without significant need for academic attention. The attributes of *social context* and *means*, by contrast, are fluid, constantly changing, unstable constructs requiring constant redefining and inquiry by academic research. The *social context* of innovation “[r]efers to any social entity, business organisation, system or group of people involved in the innovation process and the environmental factors affecting it” (Baregheh et al. 2009: 1332). Innovation leaders have a significant impact on the *social context* attribute of innovation. These leaders can successfully structure organisations and people, and plan and execute innovation initiatives. The *means* of innovation “[r]efers to the necessary resources (e.g. technology, creative, markets) that need to be in place for innovation” (Baregheh et al.

2009: 1332). Innovation leaders have a significant impact on the *means* attribute of innovation. These leaders can successfully access and channel company and external resources to test and refine new ideas in preparation for offering new products, services or processes to the market. The analysis of the *social context* and *means* attributes of innovation indicate that these two attributes are often related to each other, as indicated in Table 2 where a significant number of the studies appear in both attribute categories.

Using the same method of analysis that was applied to empirical research on innovation, contemporary master's and doctoral studies of innovation can be categorised under the *social context* and *means* attributes of the multidisciplinary definition of innovation. The fact that contemporary master's and doctoral studies can be categorised under these attributes confirms the trend in academic research to focus on *social context* and *means* issues. The challenges to achieving innovation in a business context are concealed in the social entities and resources needed and the way in which environmental conditions affect the social entities and resources.

Contemporary master's and doctoral research that focused on the *social context* attribute of innovation considered the management and leadership of innovation projects (Thomas 2010; Cui 2011; Kim 2012; Aftab 2013; Jaffer 2013; Stempihar 2013) and explored strategic and operational practices to improve the outcomes of innovation projects (Wu 2005; Hansen 2007; Mohan 2013; Peterson 2013; Boucher 2014) (Table 2). Contemporary master's and doctoral research that focused on the *means* attribute of innovation projects considered organisational learning and knowledge creation (Ramamani 2010; Johnson 2012; Acklin 2013a) and investigated organisational structures and processes (Hembree 2011; Hutchison-Krupat 2011; Acklin 2013a; Meesapawong 2013; Hardin 2014; Pease 2014; Tabbakh 2014) (Table 3).

Social context		
No	Title	Author
176	Exploring operational practices and archetypes of design thinking (2013)	Connell S.
177	Management of collaborations and conflicts in new product development (2011)	Cui Z.
178	Creative breakthrough emergence: A conversational accomplishment (2014)	Boucher R.H.
180	Using the creativity model of opportunity recognition to understand the front end of product innovation (2007)	Hansen D.J.
184	Modifying new product development process under environmental volatility and ambiguity: A fit theory for new product development process design (2005)	Wu T.
188	Antecedents and outcomes to implementing a top-down approach to platform product design (2010)	Thomas E.F.
189	Creativity in the fuzzy front end: The influence of evaluation structure and criteria (2013)	Peterson D.R.
247	Openness and strategic aggressiveness as R&D management capabilities in the context of bio-pharmaceutical industry (2012)	Kim H.R.
249	Ambiguity aversion in the front-end of innovation (2013)	Mohan M.
250	Leadership behaviours and practices in an innovation context (2013)	Stempihar L.M.
251	Harnessing innovation in the 21 st century: the impact of leadership styles (2013)	Jaffer S.
254	Design as a functional leader: A case study to investigate the role of design as a potential leading discipline in multinational organisations (2013)	Aftab M.A.

Table 3: Master's and doctoral studies of innovation with *social context* attributes

Means		
No	Title	Author
175	The innovation imperative: Not without design (2014)	Hardin D.
179	Innovation value of information technology: Impact of information technology-intensity of innovation capability and firm performance (2010)	Ramamani M.K.
181	The creation of new knowledge through the transfer of existing knowledge: Examining the conundrum of creation and control in innovation (2012)	Sexton J.C.
182	New product development innovation with creativity templates utilizing innovation reflection in units of practice (2012)	Johnson E.A.J.
183	The lean design for the developing world method: A novel lean market-based product design methodology for developing world markets that benefit consumers and companies (2014)	Pease J.F.
185	Resource allocation, incentives and organizational structure for collaborative, cross-functional new product development (2011)	Hutchison-Krupat J.
186	Improving the service design process: Process integration, conflict reduction and customer involvement (2014)	Tabbakh S.G.
187	Developing a more effective creative operations management system for creative businesses (2011)	Hembree R.
255	Managing innovation in public research and development organisation using a combined Delphi and analytic hierarchy process approach (2013)	Meesapawong P.
256	Design management absorption in SMEs with little or no prior design experience (2013a)	Acklin C.

Table 4: Master's and doctoral studies of innovation with *means* attributes

The multidisciplinary definition of innovation provides six clearly definable attributes of innovation that are common to all innovation initiatives regardless of the business discipline. Two attributes, *social context* and *means*, attract the majority of academic research activity. The *social context* and *means* attributes align with the two theoretical viewpoints for innovation research, namely diffusion theory and resource-based view theory as described in subsection 2.1.2. Both theories are concerned with people, their context and their resources. This alignment between definition and theory serves to confirm that the *social context* and company resources influenced by the business environment form the crux of research about innovation in a business context. The focus on issues of *social context* and business resources is further supported by the analysis of empirical research including master's dissertations and doctoral theses. These studies show a clear focus on the *social context* and *means* attributes, while the four remaining attributes attract significantly less attention from academic researchers. The difficulty of

achieving innovation is centred on the ever-changing and therefore dynamic cause-and-effect relationships described by the *social context* and *means* attributes of innovation.

In summary, the multidisciplinary definition of innovation and the two prevailing theoretical approaches help illustrate which aspects of innovation research attract the attention of researchers. This understanding also explains that the *means* and *social context* attributes attract the most attention because these two concepts were continually changing, whereas the other attributes (stages, nature, type and aims) tended to have a stable meaning. The empirical research on innovation leaders indicates that the synthesis of internal and external learning, experimentation, organisational structure, planning, team composition and maintaining a positive relationship between innovation initiatives and ongoing operations are concepts that have been studied.

2.2 Innovation in business

This section reviews key aspects of innovation within the business realm. The research is organised to firstly discuss in more detail the primary paradox embedded in innovation for established businesses. The paradox of operations versus innovation (subsection 2.2.1) is a complex problem in which the people of an organisation (*social context*), the resources of the organisation (*means*), and the environment in which the organisation operates attempt to successfully introduce innovation against the need to remain operationally effective. Strategy (subsection 2.2.2), leadership (subsection 2.2.3), business model innovation (subsection 2.2.4), organisational learning (subsection 2.2.5) and the design process (subsection 2.2.6) are shown to be necessary antecedents to successful innovation that is capable of overcoming barriers to innovate presented by the operations versus innovation paradox.

2.2.1 Innovation paradox

The ability to innovate in order for an established business to compete and survive remains a challenge. Established businesses are rightly focused on the ongoing operations of the company (Govindarajan and Trimble 2005). A new company is often innovative when it is initially launched, but as soon as an innovation takes hold and develops a customer base, the business focus shifts to growing the business by delivering the new product or service in the most profitable way. Ongoing operations focus on repeatability and reliability in order to make predictable profits for the business shareholders. By contrast, innovation is uncertain, difficult to repeat and requires investment of personnel and resources without a guaranteed return on investment (Moreno Luzon and Valls Pasola 2011; Napier, Mathiassen and Robey 2011; Cantarello, Martini and Nosella 2012; McDermott and Prajogo 2012; Schreuders and Legesse 2012;

Selcer and Decker 2012; Blindenbach-Driessen and Van den Ende 2014; Lin and McDonough 2014; Scott 2014; Yu, Chen, Nguyen and Zhang 2014).

The ongoing operations of the company are its lifeblood; the structure of the company is set up to exploit the existing products and services of the company to make regular repeatable returns on investment. Efforts by the company to innovate by exploring new opportunities remove resources and personnel from the operations of the company, and thus the natural tension between ongoing operations and innovation is born. The fight for personnel and resources can be destructive, leading to an imbalance between ongoing operations and innovation, which might trigger the demise of the organisation in the most extreme cases or more typically lead to the cessation of innovation activities. To innovate in an established business requires the business to manage and overcome the inevitable conflicts between ongoing operations and innovation activities. Companies require innovation for competitive advantage. Paradoxically, companies rightly focus on efficiency, reliability and repeatability to extract profit from existing products and services. Companies therefore need to learn to exploit their current offerings while exploring new business possibilities. Balancing exploitation and exploration is described as the need to be ambidextrous.

The notion that business leaders and designers view the world from different and opposing viewpoints is supported by the work of Martin (2007). “The reliability orientation of business leaders versus the validity orientation of designers creates a fundamental tension” (Martin 2007: 6). Business leaders are trained to implement measures that lead to predictable profit, and designers are trained to empathise with the user, thereby designing solutions that are responsive to their needs (Martin 2007).

In creating reliable profit, business leaders employ measurements of limited variables that are easy to quantify and compare with previous data in order to predict future profit, often referred to as linear regression (Martin 2007). Conversely, designers focus on validity, seeking deep insights about the user and contexts, and accepting many ill-defined variables, comfortable that future evidence will support their design choices that have emerged from the design process (Martin 2007). In order to create a productive relationship between designers and business executives, Martin (2007) offers five pieces of advice: appreciate that different points of view are legitimate, empathise with the unfriendly elements of the other’s domain, learn to speak the other’s language (the language of validity or the language of reliability), use tools that are familiar to the other’s domain, and reach out of one’s comfort zone to the comfort zone of the other in order to

generate proof (designers) and give innovation a chance to grow (business executives) (Martin 2007).

The continual conflict between ongoing operations and innovation has led organisations to develop strategies to manage this conflict (Martin 2007; Cui 2011; Gillier and Piat 2011; Moreno Luzon and Valls Pasola 2011; Napier et al. 2011; Cantarello et al. 2012; McDermott and Prajogo 2012; Schreuders and Legesse 2012, Selcer and Decker 2012; Van Hemert, Nijkamp and Masurel 2013; Bingham, Furr and Eisenhardt 2014; Blindenbach-Driessen and Van den Ende 2014; Leavy 2014; Lin and McDonough 2014; Löfsten 2014; Ruvio, Shoham, Vigoda-Gadot and Schwabsky 2014; Scott 2014; Yu et al. 2014; Karol 2015). In order for established organisations to deal effectively with the competing needs of exploitation and exploration, new ambidextrous organisational structures have been developed (Martin 2007; McDermott and Prajogo 2012). Ambidextrous organisational structures allow companies to conduct exploitation and exploration concurrently or in a sequential manner (Govindarajan and Trimble 2005). The ambidextrous organisational structure is a strategic intervention driven by company leadership that alters the focus of the company towards a balance between exploitation and exploration activities (Napier et al. 2011; Schreuders and Legesse 2012; Leavy 2014; Yu et al. 2014).

Existing organisational structures are designed to exploit the current competitive advantage of the firm (De Mozota 2008; Mutanen 2008; Cantarello et al. 2012). Such organisational structures include operational management, finance, accounting, marketing and other organisational sub-sets focused on exploiting current competitive advantage in a repeatable efficient manner (Barrow 2013). The organisational structure for innovation initiatives, which is also an organisational sub-set of the company, is not repeatable and routine. This is because it focuses on the exploration of new ideas (Kelley 2009; Govindarajan and Trimble 2010; Löfqvist 2010; Wei et al. 2014; Baruah and Ward 2015). The organisational structure for the innovation project (for the exploration of new ideas) is developed around the project team (Govindarajan and Trimble 2010; Slater, Mohr and Sengupta 2014). To this end, the organisational structure of the project team is informed by the need for this relationship (Govindarajan and Trimble 2005, 2010; Jiao and Zhao 2014).

The role of leadership is essential to the successful implementation of an ambidextrous organisational structure (Selcer and Decker 2012; Jaffer 2013; Scott 2014). Leaders are empowered to blend and mediate the personnel, resources and specific company environment with the ambidextrous organisational structure (Selcer and Decker 2012;

Jaffer 2013; Bingham et al. 2014; Leavy 2014; Scott 2014). Ambidextrous organisational structures are a departure from historical and contemporary organisational structures that have focused on exploitation (Scott 2014). The understanding of exploitation strategies is well developed and entrenched (Martin 2007; Scott 2014); contemporary work investigating ambidexterity thus tends to focus on exploration issues (Cantarello et al. 2012; Ruvio et al. 2014).

The adoption of ambidextrous organisational structures has led researchers to develop tools, methods and frameworks for leaders and managers to implement the ambidextrous business structure within their business environments (Martin 2007; Cui 2011; Gillier and Piat 2011; Moreno Luzon and Valls Pasola 2011; Napier et al. 2011; Cantarello et al. 2012; Schreuders and Legesse 2012). These tools, methods, models and frameworks focus on exploration issues while applying existing exploitation conventions or constructs (Martin 2007; Cui 2011; Moreno Luzon and Valls Pasola 2011; Napier et al. 2011; Van Hemert et al. 2013; Blindenbach-Driessen and Van den Ende 2014).

Organisational learning is an essential antecedent to innovation (Gillier and Piat 2011; Cantarello et al. 2012; Lin and McDonough 2014; Ruvio et al. 2014). With an ambidextrous strategy set and leadership driving this dual focus, the output that drives innovation forward is organisational learning (Gillier and Piat 2011; Cantarello et al. 2012; Lin and McDonough 2014; Ruvio et al. 2014). The process of obtaining organisational learning is embedded in design (Hardin 2014). The process of design and design management provides the activities, choices and results that move ideas to successful innovation (Ravasi and Stigliani 2012). Design and design management comprise the set of routines that explore the unknown, seek the truth about possible innovative solutions, provide evidence and industrialise winning solutions for commercialisation (Martin 2007; Cui 2011; Bingham et al. 2014). Ravasi and Stigliani (2012) argue that organisational learning is obtained through the design process.

Strategy (subsection 2.2.2), leadership (subsection 2.2.3), organisational learning (subsection 2.2.5) and the design (subsection 2.2.6) are discussed in depth to develop an understanding of how these four antecedents contribute to innovation in existing firms (Slater et al. 2014). Before the antecedents to innovation are discussed, it is important to define three distinct levels within business organisations: strategic, organisational and operational. Each of these levels has a different purpose in the organisation, and the antecedents to innovation discussed below are capable of playing a role at each of these different levels in the organisation. Understanding the purpose of these levels will help explain what type of role the antecedents can play at each particular level:

- The strategic level is concerned with setting the vision and mission of the company for the future, and is the responsibility of senior leaders.
- The organisational level is concerned with the organisational structure, management and planning of the company, and is the responsibility of senior and middle management.
- The operational level is concerned with the tactical day-to-day operations of the workforce. It is put in place by the organisational level to achieve the strategies of the company, and is the responsibility of junior and middle management.

2.2.2 Strategy

Originating from the military arena, strategy is a specific type of plan formulated by top-level leaders to achieve single or multiple goals in unpredictable conditions. Researchers have differentiated strategy from planning, arguing that strategy contains a deliberate pattern in decision-making (Mintzberg 1996). That strategy is a deliberate attempt to shape the future in order to ensure long-term success (Kvint 2009; McKeown 2012).

In management theory, where strategy is used to advance the interests of a business, the strategy is focused on formulating the competitive advantage of a company based on its environment (Porter 1979). During the 1970s and 1980s, academic studies of management developed and implemented the idea of strategy as an important activity of senior business executives. During these two decades, the predominant strategy was to maintain the success of the company. This defensive strategy focused on developing ways for senior executives to protect their corner of the market by creating barriers to entry for competitors, and it attempted to provide resistance to change and promote the status quo. In the 1990s, this defensive strategy was challenged by new strategists who maintained that change is inevitable and that defending a market position inevitably leads to the demise of the company concerned. Since the 1990s, the new strategic approach that has been widely adopted is innovation (Govindarajan and Trimble 2005). Innovation is the new offensive strategy that companies employ to survive in the face of competition and changes in the market environment. Innovation is understood and well defined in the academic literature; however, introducing innovation remains a challenge due to the paradox between ongoing operations and innovation activity, which requires different approaches and sets of skills in the organisation, planning, measurement and culture within a business (Tirpak 2017).

The purpose of strategy in business is to obtain and maintain a competitive advantage for the company (Leavy 2014). Competitive advantage is essential to the ongoing survival and relevance of the company (Cooper 2011; Chang and Wang 2013). In the

contemporary marketplace, competitive advantage tends to be short-lived (Leavy 2014). The increased pace of change has forced companies to innovate more regularly (Cooper 2011; Chang and Wang 2013; Gherasim 2013; Dustin et al. 2014; Leavy 2014). For example, established First World firms look to emerging markets with the strategy of offering products tailored to these markets (Govindarajan and Trimble 2012). In the past, First World firms supplied their First World offerings to emerging markets. The new strategy of developing products specifically for emerging markets, including the bottom-of-the-pyramid markets (Viswanathan and Sridharan 2012), indicates a clear competitive threat to the companies that exist in these markets (Govindarajan and Trimble 2012). Companies and nations situated in emerging markets need to respond to the competitive threat posed by First World organisations eager to develop a product for emerging markets. First World innovation may be countered by situated emerging market innovation.

The field of design management contributes to strategy by developing the innovation vision and strategy of organisations. The company's vision and the resulting strategy are the responsibility of senior leadership. The role of design management in innovation vision and strategy is to inform the leadership of future design possibilities for the company. The study by Topalian (2012) is a forward-looking prediction of the roles that design leadership might play in the next decade. This research adopts the position that design is the one discipline that unites all business activities (Topalian 2012). The future role of design leadership proposed by this study is to create design-led organisations (Topalian 2012; Wrigley and Bucolo 2012). Tertiary education programmes that teach design-led business principles are needed to prepare future organisational leadership (Wrigley and Bucolo 2012).

Design managers advance management thinking from traditional exploitative approaches to flexible, creative and explorative management theory (Gornick 2008). The term "design-led innovation" is used to describe future innovation trends (Celaschi, Celi and García 2011: 6). The need to foster mutually beneficial working relationships between designers and senior management is further supported by Dell'Era, Buganza, Fecchio and Verganti (2011), who maintain that management has insufficient language to describe and brief the conceptual development process. This language deficiency and lack of understanding lead to the situation in which management is unable to communicate and commercialise product innovation effectively, as they only know the final output and not the entire story. The study posits language brokering as a method for developing the necessary language skills and presents a visible product development story accessible to senior management and other relevant staff members (Dell'Era et al. 2011).

The choice to fund and undertake innovation must be accompanied by leadership setting the innovation vision and developing a strategy to achieve the innovation vision. A matching action plan then needs to be developed. The action plan comprises the design of organisational structure, company processes and the business model. The field of design management contributes to organisational structure, processes and the business model by drawing attention to the role of design in these systems. The fact that designers and senior management have conflicting outlooks for business success raises the question of why these two polar opposite paradigms need to work together within a business context. The simple answer is innovation for commercial gain (Walsh, Roy, Bruce and Potter 1993; Noble and Kumar 2010; Ravasi and Stigliani 2012). The study by Walsh et al. (1993: 80) established more than 20 years ago that “design is vital to innovation”. This study of top European and other firms revealed that successful commercial innovation is linked to the firms’ investment in design management and professional product and industrial design expertise (Walsh et al. 1993).

A recent significant growing contribution in the field of design management is its role in business strategy development (Jun 2008; Marshall 2009; Moultrie et al. 2009; Na and Boulton 2010; Rosensweig 2011; Bucolo, Wrigley and Matthews 2012; Lee and Evans 2012). Analyses of the positional forces involved in design management and strategy development linked to design activities describe strategy as the long-term planning and direction of brand and product development in the realm of design activities (Jun 2008). Typical positional forces include branding, culture, cost, technology and customer services (Jun 2008). A study conducted at Motorola by Marshall (2009) describes how design research transcends its role as purely the design of objects to become an integral part of business strategy development.

A study by Moultrie et al. (2009) reports on research and development funds spent in the United Kingdom design industry. The conceptual model confirms that funding is spent on design activities that contribute to business strategy linked to operating environments, business processes and systems, branding and corporate identity (Moultrie et al. 2009). The drive to diversify the uses and impact of design consultancies confirms that areas such as branding, innovation and strategy form part of the offerings of design consultancies (Na and Boulton 2010). The adoption of designer approaches in brand development in the fast-moving consumer goods industry has a strategic impact on the organisational culture, making companies better at adapting to new market conditions (Lee and Evans 2012). The article by Rosensweig (2011) focuses on the interaction between design and business, exploring its impact on the success of organisations. A

theoretical model identifies how design has become a dynamic capability, able to influence business strategy among other business constructs (Rosensweig 2011).

Within the business realm, design and product innovation face the challenge of overcoming concerns related to uncertainty and risk. Design leaders continually attempt to “maximise desirable and minimise undesirable uncertainties” within their design process (Rajabalinejad and Spitas 2012: 50). Using this principle, a framework for coping with uncertainty is developed (Rajabalinejad and Spitas 2012). These quantitative methods help measure uncertainty and strategically aid design management to make informed decisions about uncertainty (Rajabalinejad and Spitas 2012). An investigation of external sources of uncertainty in the design process uses design management principles to quantify the effect of external uncertainty (Rajabalinejad and Spitas 2011). The study presents tools for dealing with external uncertainty through the various stages of the design process (Rajabalinejad and Spitas 2011). Ambiguity and volatility are important variables in uncertainty (Carson, Wu and Moore 2012). Analysis of these conflicting variables leads to greater understanding of uncertainty, allowing management to alter the impact of these variables on new product development (Carson et al. 2012). The ways in which design practices differ between poor and wealthy countries show that design strategies, project requirements, negotiation behaviour and information behaviour differ (Jagtap et al. 2014). Understanding these differences may be useful in explaining strategic design practice in the South African context.

The need to gain a competitive advantage for survival is pressing. Local and international competition is intensifying (Govindarajan and Trimble 2012; Leavy 2014). A significant strategic organisational trend that is used to compete for customers is ambidexterity in the organisational structure (Kelley 2009; Hutchison-Krupat 2011; Van Hemert et al. 2013; Scott 2014; Troilo, De Luca and Atuahene-Gima 2014; Wei et al. 2014; Yu et al. 2014). Ambidexterity allows companies to exploit and explore at the same time. This strategic approach to organisational structure has proved to be effective in capturing competitive advantage (Kelley 2009; Hutchison-Krupat 2011; Govindarajan and Trimble 2012; Van Hemert et al. 2013; Leavy 2014; Scott 2014; Troilo et al. 2014; Wei et al. 2014; Yu et al. 2014). The success of this organisational strategy suggests that investigating its use in South African companies is important in order to determine whether this type of organisational structure is used locally and contributes to innovation and competitive advantage in local firms, including innovation using a company’s core competencies, management-driven innovation, innovation that matches the business objectives, innovation reflective of market reality and promotion of a corporate culture of innovation (Dustin et al. 2014; Calabrese and Costa 2015). Competitive advantage is central to

future design management and leadership trends. Maintaining a competitive advantage by understanding the company's value chain and its position relative to the larger value system of the industry is required (Gherasim 2013).

2.2.3 Leadership

Defining the purpose of leadership is straightforward. Leadership is the capacity of a person or a group of people to lead others as individuals, groups or social entities, such as large companies or institutions, towards the attainment of shared goals. However, producing a singular theory that explains leadership is elusive. Studies of leadership have produced many often-opposing theories over time. Research on leadership has evolved over many centuries, from at least as early as the original Greek philosophers. Initially, the understanding of leadership was dominated by 'trait theory', namely that leaders are born and possess specific traits that make them good leaders. The notion of trait leaders (kings, landlords and spiritual leaders born into entitlement) began to weaken in the 19th century. By the 1940s, new research argued that traits alone could not explain how leaders were effective in certain situations but not in others. This new direction investigated the behaviours of leaders that led to the effective attainment of goals. Since the move away from trait theory in the 1940s, differing viewpoints on leadership theory have rapidly multiplied. The development of many different theories about leadership has in part been the result of more sophisticated research methods. Contemporary research methods have allowed researchers to show and describe the complex nature of leadership. Another important factor that has led to the proliferation of leadership theories is the dramatic growth of contexts in which leadership roles are applied. With the advent of the industrial revolution, which led to a significant increase in the division of labour and a rapidly growing middle class, new contexts requiring leadership roles developed. Combining contemporary sophisticated research methods with significant growth in leadership contexts since the 19th century has contributed to the diverse range of theories about leadership. Table 4 below provides a summary of some leadership theories that have attracted the attention of the research community (Malos 2012; Landis, Hill and Harvey 2014) and models that have been used to measure leaders and their skills (Malos 2012).

Theory/Model	Primary Theme	Pioneer(s)
Trait	Personality characteristics	Carlyle, Cowley, Galton
Behavioural	Leader actions and behaviour	Blake & Mouton, Lewin, Tannenbaum & Schmidt
Contingency	Style depends on situation	Fiedler, Morgan,
Situational leadership	Matching the most effective leadership style or traits to the on-hand situation	Hersey & Blanchard
Power & influence	Leveraging power to accomplish goals or tasks	French & Raven
Charismatic	Inspirational and motivational	Weber
Ethical	Values-based approach	Brown & Trevino, Bandura
Authentic	Integrity and transparency	Avolio
Transactional	Compliance through rewards and punishment	Weber, Bass
Transformational	Inspire followers to change expectations	Burns, Bass
Servant	Enriching the lives of individuals	Liden, Greenleaf
Systems	Study of systems and systems thinking	Bertalaffy, and Kast & Rosensweig

Table 5: Abbreviated table of leadership theories and models (Malos 2012: 262)

Wren (1995: 325) posited that leadership is:

“In essence a process: a series of actions and interactions among leaders and followers which lead to the attainment of group goals.”

The work of Burian, Maffei III, Burian and Pieffer (2014: 262) defines leadership as:

“The blending of vision, values and contributions to society, turning ideas into reality through others that share the same vision.”

An emerging line of inquiry in leadership theory differentiates leadership theory into two paradigms. Newtonian leadership theories rely on a linear predictable understanding of the world, while the non-Newtonian leadership paradigm understands the world as complex, chaotic and volatile, in which adaptation to the environment is unique and situated (Kutz and Bamford-Wade 2013; Hunter, Cushenbery and Jayne 2017).

Comparing the two definitions from management sciences above, the first from 1995 and the second from 2014, it can be concluded that the purpose of leadership has remained constant. The recent 2014 definition, however, does specifically link leadership to innovation and turning ideas into reality. As shown in Table 4 above, leadership research is diverse. This research project focuses on how leadership contributes to innovation, particularly research that considers leadership roles for synthesising internal and external learning, leading innovation experiments, organisational design, innovation planning,

compilation and leadership of innovation teams and leadership that mediates the tension between ongoing operations and innovation initiatives in the firm.

At the strategy level, contemporary research on innovation clearly demonstrates that leadership is a critical antecedent to different innovation strategies (Song, Nam and Chung 2010; Thomas 2010; Lee, Chung and Nam 2012; Behrens, Ernst and Shepherd 2014; Felekoglu and Moultrie 2014; Slater et al. 2014). Platform product development strategies require the strategic intervention of senior leaders (Thomas 2010). The strategic decision to exploit research and development (R&D) projects rests with experienced middle and senior leadership due to their ability to focus on the strategic opportunities presented by such projects (Behrens et al. 2014; Felekoglu and Moultrie 2014; Chan, Chen, Hung, Tsai and Chen 2017). Chief executive officers who value and support design management and design-led strategies have reported significant advantages for their product brands in international markets (Lee et al. 2012; Song et al. 2010). Recent leadership frameworks and models have successfully integrated design-led strategies, arguing that design-led thinking is a wellspring for generating new ideas that leaders can adopt to differentiate their innovations from competitors (De Mozota 2008; Acklin 2010; Bucolo et al. 2012; Wrigley and Bucolo 2012). Innovation-orientated senior leadership as an established antecedent to innovation makes strategic contributions to the organisational structure, culture, human resource practices, innovation processes, and the product or service launch strategy (Slater et al. 2014; Stock, Totzauer and Zacharias 2014; Gurd and Helliard 2017). The constant barrage of changes stemming from the business environment challenges leaders to adopt ambidextrous leadership strategies allowing for exploitation and exploration to take advantage of short-lived market opportunities (Schreuders and Legesse 2012; Leavy 2014). Rapid environmental changes challenge leaders to develop strategies to integrate people, processes and behaviour into new leadership models focused on innovation for competitive survival (Burian et al. 2014; Dunne, Aaron, McDowell, Urban and Geho 2016). Leadership theories that contribute strategically to innovation are transformational leadership, transactional leadership and leader-member exchange theory (Jaffer 2013; Schweitzer 2014; Purvee and Enkhtuvshin 2015; Ilsever and Ilsever 2016; Kraft and Bausch 2016; Messersmith and Chang 2017).

Leadership involvement in new product development confirms that top management can play a significant role in innovation (Felekoglu and Moultrie 2014; Rao 2015; Caridi-Zahavi, Carmeli and Arazy 2016; Eisner 2016). This emerging role of innovation leadership links design capabilities to business strategy and vision (Wrigley and Bucolo 2012). For example, Kia and Hyundai CEOs' design-driven decisions have had a

significantly positive impact on the Korean motor company's competitive advantage within world markets (Lee et al. 2012). The choice to fund and undertake design and innovation requires support from the top (Gemünden, Salomo and Hölzle 2007; Min and Chung 2008; Song et al. 2010; Lee et al. 2012). Without senior management's willingness to engage and fund, design and innovation projects are unlikely to succeed (Gemünden et al. 2007; Min and Chung 2008). The key roles for CEOs are to be initiators and supporters of design (Min and Chung 2008). The management traits and behaviour common to CEOs who value design management are design awareness, a good sense of design, support for design and involvement in design (Song et al. 2010).

At the organisational level, the role of leadership is to maintain a positive relationship between innovation activities and the ongoing operations of the company (Jaffer 2013; O'Connor and Rice 2013; Stempihar 2013; Euchner 2015). For innovation to thrive within the operational demands of existing businesses requires leadership that understands the threat of innovation versus ongoing operations (Jaffer 2013) and has access to methods (Hembree 2011; Kim 2012; Kutz and Bamford-Wade 2013; O'Connor and Rice 2013; Chen, Tang, Jin, Xie and Li 2014; Säfsten, Johansson, Lakemond and Magnusson 2014) that can be employed to maintain the balance and harmony between innovations and ongoing operations.

At the operational level, leadership is required to lead the innovation process (Acklin 2010; O'Connor and Rice 2013; Stempihar 2013; Slater et al. 2014). Paying attention to the details of the design process and supporting the design team are leadership behaviours that have a positive impact on innovation (Stempihar 2013; Minh, Badir, Quang and Afsar 2017). Innovation leadership is in need of development, and formal training has been identified as a current deficiency (Stempihar 2013; Skurzewski-Servant 2016). As established management practices are found to be ineffective and destructive towards innovation (O'Connor and Rice 2013), design management and design leadership studies have introduced new practices that enable leaders to support and nurture innovation within businesses (Gloppen 2009; Acklin 2010; Topalian 2012; Miller and Moultrie 2013).

2.2.4 Business model innovation

Companies use their business models to bring product innovation to market (Chesbrough 2010). Chesbrough (2010) argues that business model innovation is required to ensure that new products are delivered to the consumer in the best format to maximise profit. Business models must be defined to meet particular customer needs (Teece 2010). "Great technological achievements commonly fail commercially because little attention

has been given to designing a business model to take them to market properly” (Teece 2010: 192). Recent trends in business model research find no unifying theory of the purpose of a business model (Zott, Amit and Massa 2011). Themes that are currently under investigation include innovation, value creation and value capture attained by business models (Zott et al. 2011; Crews 2016). The themes of innovation, value creation and value capture are linked to product innovation and imply that business model innovation fits within the realm of innovation in business (Chesbrough 2010; Teece 2010; Zott et al. 2011; Bucherer, Eisert and Gassmann 2012).

Value extraction describes the business model used to generate profit from the innovative solution. The nine-part decomposition of a business model described by Osterwalder et al. (2005) provides a platform for measuring the understanding that exists in South African companies for each of the nine identified parts of the business model (Figure 5). The nine parts of the model can be condensed into four main elements (Bucherer et al. 2012: 184):

- Value proposition
- Operational model, comprising key activities, key resources and a partner network
- Financial model, comprising the cost structure and revenue flows
- Customer model, comprising distribution channels, client relationships and client segments.

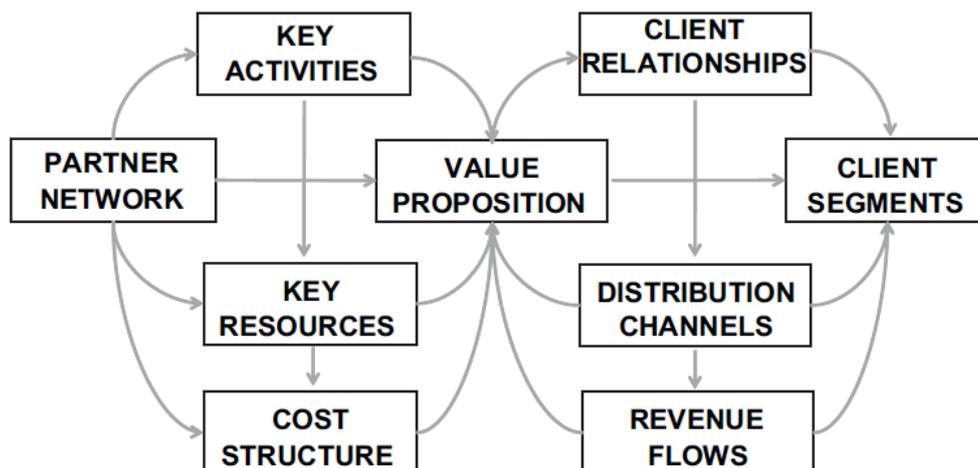


Figure 5: Business model canvas Osterwalder et al. (2005) discussed by (Chesbrough 2010: 359)

The nine-part business model canvas presented by Osterwalder et al. (2005) considers how the nine parts are combined, and the relationships between each part can be visually mapped:

- Key activities: The key activities that the company is required to perform for the product/service value proposition.
- Partner network: Key partners who provide key resources and/or key activities towards the company's product/service value proposition that do not come from within the company.
- Key resources: The company's key resources required for the product/service value proposition. These could be physical, intellectual, human or machinery.
- Cost structure: The most important costs in providing the company's products/services.
- Value proposition: The value that the product/service delivers to the customer. Value is created by differentiating the innovative product/service through a mix of technology, pricing and service enhancements.
- Customer relationships: The type of relationship that the customer requires.
- Client segments: The types of customers to whom the company sells its products/services.
- Distribution channels: The strategy that the company uses to deliver products/services to its customers, namely the channel to market.
- Revenue flows: The way in which customers pay for the value that the product/service provides.

2.2.5 Organisational learning

Over time, organisations gain experience from their operations, which allows them to create knowledge (Cyert and March 1992). Organisational learning is the process of creating, transferring and retaining knowledge within an organisation (Argote and Miron-Spektor 2011). Knowledge is not simply a collection of data or information; knowledge is gained by the application of information and experience in a particular context (Nonaka and Takeuchi 1995; Davenport and Prusak 2000).

Explicit and tacit knowledge are two distinct forms of knowledge used for organisational learning (Sanchez 2004). Explicit knowledge can easily be transferred using written, verbal or multimedia formats (Sanchez 2004). Tacit knowledge is complex in nature and difficult to transfer. Tacit knowledge is absorbed over time and gained through personal experience (Polanyi 1962; Sanchez 2004). Innovation within the context of an

organisation is not possible without organisational learning (Fernández-Mesa, Alegre-Vidal, Chiva-Gómez and Gutiérrez-Gracia 2013). This implies that companies must be capable of creating knowledge from their experiences, transferring this knowledge across the company, and retaining this knowledge in order to innovate. The process of organisational learning (namely creating, transferring and retaining knowledge) does not happen by chance. Organisational learning is the result of a purposeful strategy developed by the leadership of the company. Innovation, strategy, leadership and organisational learning are thus inextricably linked to one another (Garvin, Edmondson and Gino 2008).

Knowledge creation occurs in organisations when individuals or teams reflect on the experiences gained from activities such as production, marketing, distribution, customer feedback and competitor monitoring. In reflecting on these experiences, organisations might, for example, learn about problems or missed opportunities. The knowledge gained from these experiences is unique and specific to the organisation (Audia and Goncalo 2006; Taylor and Greve 2006; Argote 2011). Of the three stages of organisational learning (namely knowledge creation, knowledge retention and knowledge transfer), knowledge creation receives the least attention from organisational research (Antonacopoulou 2009). Despite this, other fields such as design and design management have produced a rich source of research concerned with knowledge creation that is applicable to organisational learning (Acklin 2013b; Fernández-Mesa et al. 2013). For example, prototyping helps practitioners reframe failure, creates opportunities for learning, supports a sense of progress and strengthens beliefs about creativity. This practice also helps employees manage in uncertain conditions (Gerber and Carroll 2012). Building the right innovation team includes forgetting destructive operational culture, borrowing new ideas from external sources and learning through this process. Innovation planning as a system for learning can be constructed by posing a hypothesis and mapping the cause-and-effect relationships that the hypothesis produces (Leavy 2011). Strategic experiments provide rapid learning and differ from conventional planning in the following ways: the level of detail must be limited to a few critical unknowns; cause-and-effect relationships must be developed to explain underlying assumptions; trends rather than specific dates must be measured; frequent (monthly) strategic reviews must take place; and the historical trends of the strategic experiment must be reported on (Govindarajan and Trimble 2005).

Knowledge transfer investigates how companies spread the knowledge gained through experience (Argote and Miron-Spektor 2011). Leaders strategically use the organisational culture, structures and knowledge management systems to achieve

knowledge transfer (Hansen 1999; Regans and McEvily 2003; Jensen and Szulanski 2007). The impact of the external (source team) knowledge on knowledge absorption by the internal team (recipient team) is studied to determine effective knowledge absorption strategies (Abecassis-Moedas and Mahmoud-Jouini 2008). Dynamic resource allocation portfolios might replace the static resource approach that has been used until now in organisational learning ambidexterity theory (Wei et al. 2014). The research confirms that new knowledge required for innovation is created as a result of knowledge transfer within the firm. Knowledge transfer is significantly affected by company controls of existing knowledge (input, structure and output) (Sexton 2012). The study identifies the concept of routines as the most effective method for connecting learning cycles at the various levels (namely individual, team and organisation) (Hoeve and Nieuwenhuis 2006).

Knowledge retention attempts to safeguard this knowledge in some form of knowledge repository. Recording and effective access to knowledge are attempts to avoid knowledge decay, which occurs naturally over time (Darr, Argote and Epple 1995; Benkard 2000). The challenge of choosing which knowledge is still relevant and which knowledge has become irrelevant to the organisation's competitive survival are significant to knowledge retention. Current research directions include a knowledge management system to store knowledge acquired during the user-centred design of next-generation information appliances. This might be useful as a general method for a design manager to record, store and use design information (Park 2011). Knowledge-based systems are useful to designers, as they support the re-use of previous design efforts. This is argued to be relevant due to the shift towards knowledge-based economics, as designers have not made use of knowledge-based systems in the past (Reed, Scanlan, Wills and Halliday 2011). This research confirms that a firm's commitment to information technology investment plays a vital role in innovation characteristics and behaviour; contributes towards a firm's process and product innovation activities; and assists in changing the innovation behaviour of the firm through the clarification of conditions for innovation and appropriate guidance on successful innovation strategies (Ramamani 2010).

Extracting value from organisational learning makes it is possible to innovate by reducing costs, expanding and creating new markets (Linton and Walsh 2013). Not all learning is easily absorbed, and the study by Acklin (2013a) found that absorbing design knowledge capabilities can be problematic. Compared to design capabilities, the study found that design management capabilities are easily absorbed by companies that are new to design (Acklin 2013b). In contrast, design capabilities are not easily absorbed; the research found that this is due to the fact that design management connects to prior company knowledge and is managerial in nature (Acklin 2013b). This finding supports

the integration of design into a management function to ensure absorption. The study by Fernández-Mesa et al. (2013) investigated design management capabilities and product innovation in small and medium enterprises. The research presents design management as a dynamic capability, analysing its mediating role between organisational learning capabilities and product innovation performance (Fernández-Mesa et al. 2013). The study found that organisational learning (knowledge), design management (creativity) and product innovation (value extraction) are linked (Fernández-Mesa et al. 2013). The research contends that innovation performance relies on successful organisational learning and design management (Fernández-Mesa et al. 2013).

Previous studies have shown that organisational learning processes are temporal and contextual, occurring through social relationships (Pittaway and Rose 2006; Zhang 2007). Studies of organisational learning have developed methods to measure this capability. The five dimensions of organisational learning capabilities supported by the work of numerous authors (Isaacs 1993; Nevis, DiBella and Gould 1995; Bapuji and Crossan 2004; Chipika and Wilson 2006; Chiva and Alegre 2009) are:

- Sympathy for experimentation
- Risk-taking, tolerance for ambiguity, uncertainty and errors
- Maintenance of interaction with external environments
- Dialogue as collective inquiry into the processes, assumptions and certainties of everyday experiences
- Participative decision-making; the influence of employees on the decision-making process.

New knowledge created by external sources also contributes to organisational learning. Innovation in which companies specifically outsource technology and designers leads to a more experimental approach than innovating only with internal staff members (Dell'Era, Marchesi and Verganti 2010). Why some firms use external partnerships to strengthen innovation while other firms do not depends on the willingness of the firm's innovation culture to use external partners (Brettel and Cleven 2011). "Innovation is one of the most critical means of supporting and improving the competitive position of the firm" (Cantarello et al. 2012: 28). A balance between existing knowledge and new possibilities for exploitation is required (Cantarello et al. 2012). In this context, the study by Cantarello et al. (2012) investigates how organisations achieve this need for ambidexterity, specifically in the search phase for new ideas. The way in which a lasting balance in the ambidextrous capability can be maintained in organisations is not well understood

(Cantarello et al. 2012). Design managers may provide a means of creating a lasting balance between exploration and exploitation due to their influence and experience spanning the whole innovation process.

The move towards knowledge-based economies justifies investigating methods to capture design intent in knowledge-based systems (Reed et al. 2011). Codified knowledge-based systems to support design re-use can be adapted to capture design intent and therefore provide an effective way to capture, manage and use design-based knowledge within companies (Reed et al. 2011). Other potential uses for knowledge in knowledge-based economies are data-capturing systems that analyse customer needs and manufacturing capabilities (Xu et al. 2009), which might provide methods for measuring the optimal trade-off between consumer satisfaction and producer capacity (Xu et al. 2009).

Studies of the curricula of courses that teach innovation advocate the notion of multidisciplinary training. The study of 16 leading schools in the United States of America found that teaching innovation through experiential learning activities, themed around product design and development, established the legitimacy of multidisciplinary training (Fixson 2009). The creation of innovative ideas requires multidisciplinary training that covers business and design concepts to prepare undergraduate students for the world of work (Teixeira 2010). Multidisciplinary (business and design) training can be applied to students of any discipline, as innovation is pervasive in all aspects of life and study directions. Examples of multidisciplinary business and design training for innovation are the studies by Rousseau (2012), which challenge business schools to include evidence-based management and related practices of design in their curricula, and the study investigating structured methods to teach the management of business innovation for creative products (Fernandes, Da Silva Vieira, Medeiros and Natal Jorge 2009). Design can be considered as an act of business leadership and management due to the fact that design requires analysis, synthesis and evaluation by considering existing problems and designing future solutions (Lawson 2005).

The Delft Design School has been teaching product innovation models over a long period (Buijs 2003). Early models used linear logical order, while recent models are described as circular chaos in nature (Buijs 2003). The linear models are preferred for teaching purposes, but circular chaos models more closely emulate reality and the practice of innovation in organisations (Buijs 2003). The researcher contends that both linear and circular chaos models are useful and can be described as different sides of the same coin. The most suitable model is thus dependent on the preferences of the innovator (Buijs 2003). Reflection and refinement of both linear and circular model parts are

encouraged in order to tailor-make a model that suits individuals and the contextual circumstances (Buijs 2003).

2.2.6 Design process

“Innovation is a business imperative. It is the lifeblood of every organisation, without which customers are lost. The most successful, innovative companies recognise that innovation does not happen without design, which enables connections with individuals, communities, societies, and cultures; and changes existing situations into preferred ones while driving economic value.” (Hardin 2014: 72)

The notion that “[i]nnovation does not happen without design” (Hardin 2014: 72) addresses the value of design for the innovation process. Originally the role of design for innovation was at the operational level of applying skills and knowledge to innovation projects. The first designers created drawing plans that explained the construction of products from the industrial revolution era. Since then the role of design has grown; at the beginning of the 20th century, the first contributions to the organisational level (design management) were made. Peter Behrens, a designer for AEG between (1907–1913), coordinated various design disciplines to successfully achieve business objectives that demonstrated the competitive potential of design for innovation (Schwartz 1996). Behrens coordinated the functional design of products, the logo design and branding of AEG, and the design of the marketing initiatives (Schwartz 1996). In the 1980s, design managers began to elevate design to the strategic level, and business leaders started to use design for the development of strategic objectives. Design was used to visualise and communicate future scenarios; design also brought new ways of thinking, known as design thinking, to the strategy arena. Design has contributed to innovation in business at the operational level for over 200 years, at the organisational management level for 100 years, and at the strategic level for approximately 35 years.

Over this period, two distinct approaches to the design process have emerged: the rational model (Royce 1970; Simon 1972; Phal and Beitz 1996; Brooks Jr 2010) and the action-centric model (Cross and Roozenburg 1992; Ralph 2010). Both approaches are often described by different names. Essentially, the rational approach attempts to solve problems by optimising design ideas against known constraints and objectives that are plan-driven and follow a clearly defined sequence of stages. This approach is also referred to as first-order design and problem-solving, which deals with designing the underlying technology present in new products, services and processes created by science and engineering. The action-centric approach attempts to observe problems

within their contextual environment, giving value to the experiences of the actors. The design process is improvised based on observation, and the sequence of the design stages is flexible. This approach is also referred to as second-order design and problem-solving, focused on the user packaging and presenting the underlying technology into a product, service or process solution that is acceptable to the customer (Krippendorff and Butter 1984; Krippendorff and Butter 2007). Both design approaches are valid; aspects of each can also be blended together to achieve the desired results. Irrespective of the approach or blend of approaches, all design processes have commonality in how designers think.

All people are designers, capable of solving problems through design; however, the world today is a complex place, and contemporary problems and solutions often require specialised knowledge and skills. The design process described by Lawson (2005) attempts to clarify how designers think and what design processes they follow. He indicates that the design process is unique each time it is applied and that the problems and solutions constantly change and evolve (Lawson 2005). Apart from identifying the problems and solutions, he also identifies three common activities in all the design processes, namely analysis, synthesis and evaluation (Lawson 2005). He argues that these activities do not follow a specific sequence, and that designers use analysis, synthesis and evaluation in a unique and often unstructured manner, which leads to frequent refining and restating of the problem and solutions (Lawson 2005). He describes this as a highly complex mental process that takes place in the mind of the designer (Lawson 2005). The design process described by Lawson (2005) is applicable to both first- and second-order understanding.

At the strategic level, design thinking has gained popularity in dealing with problems in fields such as information technology, business, education and medicine (Dorst 2011; Johansson-Sköldberg, Woodilla and Çetinkaya 2013). The core of design thinking is to develop solutions in ill-defined complex environments in which only the final value proposition has some form of definition (Dorst 2011). The findings of Liedtka (2014) confirm that design thinking is a distinctive management practice that requires increased attention from scholars. Design thinking methodology aids business decision-makers to improve the outcomes of the innovation process (Liedtka 2014). The design thinking methodology, in particular, helps in overcoming the cognitive bias of decision-makers and contributes to stronger and more relevant innovations (Liedtka 2014).

At the organisational level, design management is responsible for the effective use of design for innovation. The field of design management stems from two separate fields of

study, namely design and management (Erichsen and Christensen 2013). Each field has its own ontological underpinnings, with design research centred on the humanist paradigm, while management research centres on the functionalist paradigm (Erichsen and Christensen 2013). Design management is thus a combination of these two fields, challenging traditional perspectives, deep-rooted paradigms and assumptions in both fields (Erichsen and Christensen 2013). Contemporary design issues in business help explain the value and relevance of design in the business realm. Within the business management realm, there has been a tendency to favour quantitative analytical methods to make sense of the business world (Aken 2004). The research by Aken (2004) argues that management research lacks relevance and suggests including prescription-driven research as found in design sciences (Aken 2004). This approach includes field-testing and grounding research with technology rules (Aken 2004).

“Design management encompasses the ongoing processes, business decisions, and strategies that enable innovation and create effectively-designed products, services, communications, environments, and brands that enhance our quality of life and provide organizational success. Simply put, design management is the business side of design.” (Design Management Institute 2014: 1)

The Design Management Institute’s (DMI) Design-Centric Index 2013 compared the stock value of design-centred organisations to Standard and Poor’s Index 500 (S&P Index 500) over a ten-year period and found that design-centred organisations have 228% higher stock value than S&P Index 500 organisations, as shown in Figure 6 (Design Management Institute 2014). The ten-year trend indicated that the importance of design-driven innovation to stock value is increasing. These results make a compelling case for the use of design management as a business process in organisations to create innovation and competitive advantage.

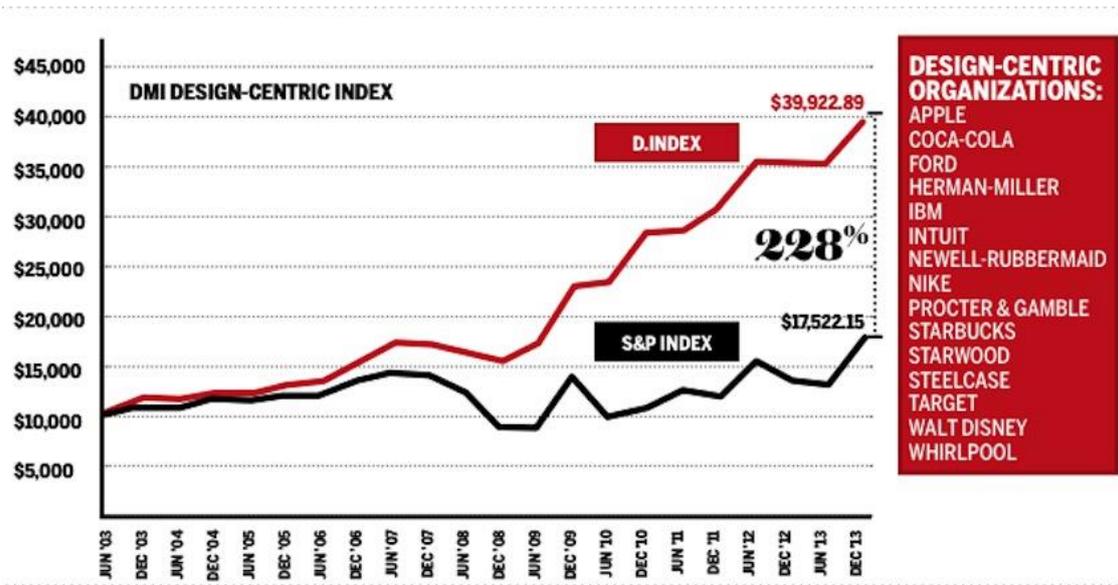


Figure 6: Design-Centric Index 2013 (Design Management Institute 2014: 1)

In 2013, Warwick Business School in collaboration with the Design Council (United Kingdom) conducted research on the role of design in business and education. The research considered the extent to which design is embedded in company culture, using the design ladder created by the Danish Design Centre. The research concluded that design benefits companies most at steps 3 and 4 of the ladder, where design is integrated into the business either as a process (step 3) or as a strategy (step 4), as depicted in Figure 7.

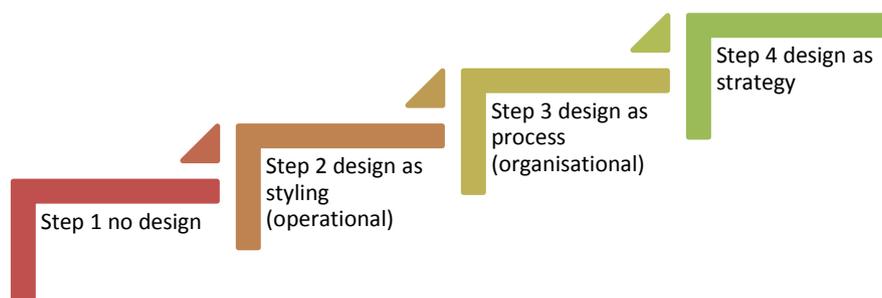


Figure 7: Design ladder (Danish Design Centre 2003: 1)

At the operational level, designers contribute to the work of the innovation team. Equipped with design process training, designers play a central role in moving innovative ideas forward. The introduction to design skills discussed important theoretical foundations for design within the business realm. The design skills discussion focuses on contemporary design skills that have been studied in a business context in order to make a contribution to innovation in the business place. Design is the day-to-day tangible face of innovation, the game plan that leaders and managers use to transform organisations into innovative companies (Rosensweig 2011; Bucolo et al. 2012; Topalian 2012).

The work of Fernández-Mesa et al. (2013) confirms that design management acts as a mediating variable between organisational learning and innovation. The result that design management is a positive mediating variable for organisational learning confirms that knowledge and creativity are linked variables for innovation. Developing an understanding of how knowledge and creativity interact and contribute to innovation is therefore worthwhile. The work of Dickson, Schneier, Lawrence and Hytry (1995) established five essential design management skills that have been revised and adapted by Fernández-Mesa et al. (2013: 550) to measure how effectively companies manage the five skills factors of design management, namely:

- “Basic skills that involve managing the basic activities of the design process in order to design high quality, manufacturability and low cost into products, and to ensure that new products are designed and launched rapidly.”
- “Specialised skills, which refer to the ability to manage certain specialised activities required for the product design process.”
- “Involving others, which means involving customers and suppliers in the design process in order to get new product ideas.”
- “Organisational change, which is the ability to manage change, both generally and in relation to moving towards concurrent design and cross-functional team management.”
- “Innovation skills, which represent the ability to manage innovation through awareness of and knowledge of competing innovations and limitations as a source of radically new design ideas.”

This section seeks to provide a picture of the significant volume of work describing design that is integrated into the business realm. Studies of this nature are usually presented under two headings, namely design management and new product development (NPD).

The literature under these two headings essentially contributes to a single field of study, namely the study of design in business. The discussion of studies under these two headings has therefore been combined. The concept of design management was introduced in 1965; since then the field has developed into an emerging field of inquiry that has received little attention from outside the design research community (Erichsen and Christensen 2013).

Although the reasons why design is necessary to business and requires management to be effective are understood, the challenge to integrate and manage design remains (Noble and Kumar 2010, Ravasi and Stigliani 2012). Adding to the study of Noble and Kumar (2010), which attempts to better understand the realm of product design in a business context, the study by Ravasi and Stigliani (2012) reviewed product design across the broad domain of business studies. This study comprised a significant volume of work (the final selection consisted of 125 articles and 20 books) and was categorised into three lines of inquiry: design activities, design choices and design results. Management studies contributed to product design firstly, through a broad map of the lines of inquiry about product design in business studies; secondly, the broad map indicated the possibilities for research across the different lines of enquiry indicating opportunities for cross-fertilisation; and thirdly, the review identified the significant but ignored subject of the organisational context of design.

The review of the literature indicated that the business studies domain had paid insufficient attention to the way in which design exists within the organisation. Researchers argue that design, like any other activity within the organisation, is socio-cognitive, influenced by social constructs within the organisation as well as the broader situated market economy in which the organisation exists. Research suggested that future studies using theories and methods from management studies might provide new insight and a better understanding of the existence of design in organisations. This might include qualitative observation methods to generate insight that could be further tested with quantitative methods to better understand the contribution of design in the business management realm (Ravasi and Stigliani 2012).

Designers, design managers and design leaders are interdependent but operate at various levels within organisations. Each has a different role with different sets of objectives. The designer's objectives are to apply the design process to innovation projects. The design manager orchestrates and balances the activities of the innovation team within the structure and ongoing business of the organisation, and the design leader focuses on design strategy and the forward-looking vision for innovation.

In summary, addressing the innovation paradox is essential to maintaining an effective blend of exploratory and exploitative activities in established businesses. Understanding that innovation is a proactive strategy under the control of the organisation to maintain its relevance by developing new competitive advantages, requires leadership, reframing business models through the processes of organisational learning and design.

2.3 Innovation in South Africa

This section discusses the existing innovation landscape in South Africa. Subsection 2.3.1 describes how innovation has developed in post-apartheid South Africa. Subsection 2.3.2 discusses the two South African innovation surveys conducted in the period 2000–2010 and subsequent academic reviews of this survey data. Subsection 2.3.3 discusses the development of a knowledge-based economy in South Africa. Subsection 2.3.4 discusses the recent intensification of innovation intent in South Africa from 2010 onwards, including private-sector and governmental initiatives. Subsection 2.3.5 discusses the limitations in understanding of innovation leadership in South African companies.

2.3.1 Innovation in the new South African democracy

Research investigating the South African post-apartheid innovation context provides insights into the contemporary innovation landscape of South Africa. As an initial step to address this need for innovation, the South African post-apartheid science and technology policies of the mid-1990s adopted the national system of innovation (NSI) to stimulate South African innovation (Lorentzen 2009). Fifteen years later, research on the impact of the NSI was critical about the suitability of this off-the-shelf policy borrowed from developed First World economies (Lorentzen 2009). The NSI policy does not take into account the unique South African and regional dynamics of an emerging economy with skills shortages and a large youth population profile. Rooks and Oerlemans (2005: 1224), who assessed the effectiveness of the South African NSI, found that compared to European firms, South African firms experience problems with innovation projects due to:

- “Insufficient knowledge of technological innovations”
- “Insufficient venture capital”
- “Insufficient skilled labour”
- “Restrictive government regulations”

The findings suggest that future research should investigate how skilled labour, including the role of innovation leaders, could be developed in the South African context to ensure that South African firms are better equipped to create new knowledge, attract venture capital and commercialise innovations (Rooks and Oerlemans 2005).

2.3.2 South African innovation environment

The 2005 South African Innovation Survey indicated that 52% of South African businesses were engaged in innovation during the period 2002–2004 (Blankley 2007). The most significant part of expenditure on innovation in these companies (65%) was

spent on the acquisition of machinery, equipment and software (Blankley 2007). Only 20% was spent on in-house research and development (Blankley 2007). The final 15% was shared between outsourced research and development and externally purchased knowledge (Blankley 2007). Information and communication technologies (ICT), especially software development, were prevalent in the service sector, providing solutions to banking, insurance and retail firms (Kahn and Hounwanou 2008). International partnerships were found to be important to South African companies (Bakker, Oerlemans and Pretorius 2008); in particular, innovation from international partners that is easy to digest and understand without the need for tacit knowledge has positive outcomes for South African firms (Bakker et al. 2008). It was also found that multiple international partnerships were less successful (Bakker et al. 2008).

The results of the second South African Innovation Survey of 2008 indicated that 65.4% of companies had innovation activities (Moses et al. 2012). Although the survey indicated that a high percentage of South African companies were involved in innovation, only 27.2% successfully introduced innovation to the marketplace (Moses et al. 2012). Data from the first South African Innovation Survey (2005) confirmed that innovation management resulted in an improved market position for South African companies (Oerlemans, Rooks and Pretorius 2005). However, improvement requires well-structured innovation management that combines internal strategies with external knowledge (Oerlemans et al. 2005).

Secondary studies of South African Innovation Survey data conducted by the Centre for Science, Technology and Innovation Indicators (CeSTII) at the Human Sciences Research Council such as those by Oerlemans et al. (2005) and Moses et al. (2012) focused on the measurement of the innovation landscape in South Africa. The findings of these surveys and the subsequent academic articles that interrogate the survey data attempt to provide a generalised big picture of innovation across all sectors of business in South Africa. Recent studies commenting on the South African innovation context recommend the following interventions to stimulate a stronger South African culture of innovation at the company level (micro level):

- Conduct research to better understand innovative South African companies (Lorentzen 2009)
- Conduct research that provides insights into organisational routines, processes and the drivers of innovation inside companies (Lorentzen 2009)

- Develop South African innovation policies that focus on company-level business skills development, including creative thinking and problem-solving to encourage innovation (Booyens 2011)
- Conduct research to investigate successful value-extraction strategies that allow innovative start-ups to successfully transition to sustainable businesses (Blankley and Booyens 2010; Booyens 2011).

2.3.3 South African knowledge-driven economy

An investigation of the Department of Science and Technology's (DST) Ten-Year Innovation Plan (2008–2018), which aimed at driving towards a knowledge economy for South Africa, found that barriers to innovation in South African companies include reluctance to venture into the unknown and experiment with new technology and new business models (Blankley and Moses 2009). South African companies tend to want to stick to conventional planning practices that are not innovative by nature (Blankley and Moses 2009). A study by Blankley and Booyens (2010) argues that to build a knowledge economy in South Africa requires economic development strategies focused on innovation and education (Blankley and Booyens 2010). The study argues that policies that develop competitive structures and strong organisations capable of dealing with competition and market forces are required (Blankley and Booyens 2010). A study by Booyens (2011) recommends that South African innovation policy must include business skills development and training with respect to creative thinking and problem-solving to encourage a culture of innovation (Booyens 2011). A recent study of Southern African manufacturing companies supports the notion that innovation is essential to achieving competitiveness (Kumar and Bergstrom 2013). This regional study recommends that local governments focus on building and strengthening technology capabilities and innovation at the company level (Kumar and Bergstrom 2013). This might be achieved by promoting a culture of technology and innovation through human capital and skills development at local tertiary institutions (Kumar and Bergstrom 2013).

A report on innovation and labour market intelligence in South Africa pointed out that labour skills across all levels were important for innovation, from basic manufacturing to artisans, management, engineers and science levels of labour, stating that: In the context of the NSI, skills are a fundamental enabler of innovation activity. Innovation and skills development are thus intertwined, described as co-evolution. Studies by (OECD 2007; Blankley and Moses 2009; Gastrow 2012) indicate the importance of the non-science and technology workforce in developing and diffusing innovation. Absorbing knowledge from other more advanced countries facilitates catch-up (Gastrow 2012).

2.3.4 Intensification of South African innovation activity

The annual South African Innovation Summit (2018) showcases some of the innovation activities taking place in South Africa; companies, start-ups and agencies involved in innovation are represented at the summit. The Accenture Innovation Conference (2014) and its publication of the Accenture Innovation Index attract a large audience for the international speakers discussing innovation topics at the conference. Innovation events of this nature indicate that South Africans are interested and willing to learn about innovation and how it could benefit their businesses. Companies also make use of local innovation communities to aid in the development of new products, processes and services. The Industrial Development Corporation (IDC), Technology Innovation Agency (TIA), Innovation Hub and South African Bureau of Standards' Design Institute are examples of innovation communities that assist companies and entrepreneurs to develop new products, processes and services.

The first and second South African Innovation Surveys (2005 and 2008) attempted to measure innovation activity in South Africa across all sectors during this period from a relatively neutral standpoint. The South African Accenture Innovation Index (2013 and 2014), by contrast, strongly advocates for innovation and attempts to compare leading South African innovative companies with the rest of South African companies. The results of the index strongly support innovation as a key driver of economic success and sustainability. Both the South African Innovation Survey and the Accenture Innovation Index identify skills scarcity as a barrier to successful innovation. Efforts to grow the pool of skilled labour that could contribute to innovation is therefore of national importance. The National Development Plan's (NDP) Vision for 2030, at its core, focuses on the capabilities of both South Africa as a country and its citizens, including education and skills training of citizens to obtain these capabilities:

“Helping people to develop their skills and enhance their capabilities is an essential part of a sustainable strategy for tackling poverty. Education, training and innovation are central to this. Highly educated and trained individuals have much better chances in the labour market and a nation with highly educated citizens, particularly in science, engineering and technology, and the humanities is more competitive and will be able to participate in the knowledge-driven economy of the future. The national economy benefits when there is a critical mass of highly skilled people as the current skills shortages have raised the cost of many vital skills.” (National Planning Commission 2012: 294).

Each country's economy is unique, shaped by a multitude of internal and external attributes (Govindarajan and Trimble 2012; Jagtap et al. 2014; Torres-Baumgarten and Rakotobe-Joel 2017). The South African economy has attributes common to both First and Third World economies. Some business sectors are abreast and compete with First World economies, such as the financial services sector, and some sectors service a vast bottom-of-the-pyramid market, such as private taxi organisations. South Africa has a unique blend of First and Third World attributes that shape its emerging economy. From an innovation point of view, South Africa's unique emerging economy is important for the following reasons, based on the multidisciplinary business definition of innovation:

- The *social context* attribute: The unique blend of First and Third World markets that co-exist creates a unique social environment that has First World aspirations, while being sympathetic and proactive towards the bottom-of-the-pyramid markets (OECD 2011; Gastrow 2012).
- The *means* attribute: Frugal company resources often have to balance small pockets of expertise and technological know-how with large pools of the under-skilled and inexperienced workforce. This resource mix implies a focus on innovation that services the bottom-of-the-pyramid market space, solving systemic problems as opposed to problems at the leading edge of technology (Govindarajan and Trimble 2012; Pervez, Maritz and De Waal 2013; Schuster and Holtbrügge 2014; Senyard, Baker, Steffens and Davidsson 2014).
- The *aim* attribute: The aim of innovation is to differentiate the company from its competitors, thereby offering a competitive advantage. The uniquely South African economic environment differentiates the outlook of people working in South African companies from those in First and Third World economies, who fit somewhere in between. This unique outlook creates opportunities for differentiation and competitive advantage that need to be seized and acted upon (OECD 2011; Gastrow 2012; Govindarajan and Trimble 2012).

Given the evidence of limited understanding of innovation in South Africa, developing an understanding of how innovation has been executed successfully in South African companies provides a new understanding of how these companies have used the unique attributes present in the South African socio-economic environment to succeed (Lorentzen 2009; Cunha, Rego, Oliveira, Rosado and Habib 2014; Pease 2014; Senyard et al. 2014).

The National Advisory Council on Innovation's 2015 report calls for the development of greater understanding of the innovative firm in South Africa (National Advisory Council on Innovation 2015). The OECD (2011) report on the South African National Innovation System indicates that insufficient attention is given to indigenous knowledge; activities in the informal economy; the role of non-R&D capabilities in the areas of engineering, design and related management; or the role of foreign direct investment in domestic innovation.

Studies of design and innovation processes in developing economies have identified that these processes differ from similar processes in First World economies due to contextual differences (Viswanathan and Sridharan 2012; Pervez et al. 2013; Jagtap et al. 2014; Schuster and Holtbrügge 2014). The context of a multicultural company workforce has been shown to contribute to success in the South African business environment (Urban 2008; Daya 2014; Daya and April 2017). The context of resource scarcity prevalent in emerging economies stimulates improvisation and frugality as strategies to overcome resource deficiencies (Cunha et al. 2014; Schuster and Holtbrügge 2014; Weiss, Hoegl and Gibbert 2014).

In addition to contextual issues that apply to emerging market conditions, two contextual challenges relevant to all First World and emerging economies are significant and merit discussion, namely the challenges of complexity and uncertainty. Complexity refers to the number of technologies and how they interact with the company (Tidd 2002). Uncertainty refers to the rate of technological change and market conditions external to the company (Tidd 2002). Both complexity and uncertainty challenge the leadership and management of new innovative initiatives. Developing contextually relevant alignments with complexity and uncertainty are shown to improve innovation management and performance (Tidd 2002; Kutz and Bamford-Wade 2013; Behrens and Ernst 2014).

The 2013–2014 NACI annual report points out that the National Development Plan Vision 2030 places significant emphasis on innovation as a means for economic, social and environmental development (National Advisory Council on Innovation 2015). In response to the NDP Vision 2030, the NACI council presented a holistic National Innovation Framework that considers human capital, research and development, intellectual property, venture capital, commercialisation of know-how, an enabling environment for entrepreneurship, and the policy and regulatory framework for innovation. In order to develop the holistic innovation policy framework, NACI actively formulated and worked on several policy focus areas (NACI 2015). Policy focus area number five (bio-economy) studied the causes of the failure of biotechnology start-ups and listed lack of business skills among managers as the most significant reason, accounting for 30% of the start-up

failures. The management skillset, which includes innovation management and leadership, is clearly lacking in this environment. The policy focus area calls for the use of case studies of South African businesses with successful innovation projects to contribute to local knowledge and understanding of which innovation management and leadership activities create success. Policy focus area number six (innovation for economic development and social upliftment) recommends interventions to address a number of challenges, including entrepreneurial and management skills that support innovation. Flagship innovation projects with proven innovative solutions are suggested as interventions that could provide learning for entrepreneurial and management skills development.

The holistic innovation policy presented by NACI (2015: 8) is broad-based, with the intention of making a positive impact on innovation in South Africa in the following arenas:

- Research and development is an arena responsible for the development of knowledge based on scientific investigation. The new knowledge developed from research and development is an important antecedent to innovation in a business context. However, a significant proportion of this knowledge is not immediately applicable to the business context for commercial exploitation. The challenge is to produce focused new knowledge that has immediate commercial potential.
- The human capital development arena in the form of adult education and training that contributes to innovation, entrepreneurship, technology and the knowledge economy is essential to advancing innovation in South Africa. Significant emphasis is placed on education in South Africa, and constant emphasis by the government, the private sector and the citizens of South Africa on education and innovation will move innovation forward. The challenge is to focus continually on education that is relevant to economic upliftment.
- The intellectual property arena aids in the protection of commercially competitive knowledge. Providing a protected space for new innovations to take hold and flourish in the marketplace without the threat of being copied unlawfully by competitors is necessary. The challenge is to maintain and police the competitive advantage space created by intellectual property rights.
- The venture capital arena provides funds for new innovations. The challenge for venture capital is to develop suitable categories for investment and educate innovators about the functional requirements for each category in order to prepare innovations appropriately to receive funding.

- The entrepreneurial arena provides a set of skills and a way of thinking about contemporary problems that can be solved by offering a commercial solution. The challenge is to educate young adults in entrepreneurial skills and thinking.
- The policy arena is intended to provide appropriate guidelines for innovation in South Africa. The challenge is to develop an understanding of local innovation and policies that enable local innovation to flourish and make a socio-economic contribution to South Africa.
- The regulatory framework arena must create opportunities for South African innovation. The challenge is to balance a complex set of local and international variables that encourage stability in continued economic relationships while assisting local innovation.
- The commercialisation of the know-how arena is where the role of business is central to successful innovation. The challenge is to understand how innovation leaders in South African businesses successfully execute innovation.

Considering the eight broad-reaching arenas of the NACI framework innovation policy, this research focuses on the commercialisation of know-how in the South African context. This research intends to contribute to the commercialisation of know-how by investigating how leaders tasked with innovation in selected South African companies successfully introduced innovation to the market.

Identifying and solving customer problems by using the process of innovation in South African companies is not well understood (Blankley and Booyens 2010; Booyens 2011). The “black box of innovation”, a description coined by Lorentzen (2009: 33), calls for research that demystifies how innovation occurs in South African companies, which operate in the context of a national skills shortage.

2.3.5 Limitations in understanding innovation leadership in South Africa

As established earlier in the literature review (subsection 2.1.3), the *means* and *social context* attributes of the innovation process within the business realm require ongoing investigation due to the dynamic and ever-changing business contexts in which innovation takes place. Section 2.3 of the literature review specifically builds a picture of the understanding of innovation in the South African context, in particular an understanding of the *means* and *social context* attributes in South African businesses. The theory developed for the *means* and *social context* attributes of innovation can be divided into two groupings. Firstly there has been a grouping of studies and reports from academia,

government, international organisations and local policy that identify strengths and weaknesses of innovation in South Africa. Included in these studies, reports and policies are recommendations for further research into the understanding of innovation in South Africa. For example the OECD (2007) recommends developing a better understanding of the roles of design, engineering, entrepreneurial and management skills for innovation in South African companies. This group of studies, reports and policies is helpful in presenting the status quo of innovation in South African companies and recommendations for further areas of study (Table 5).

Group 1: Understanding and recommendations for further study of innovation in South Africa		
1	Innovation in South Africa is negatively affected by insufficient knowledge, funding, skilled labour and restrictive governmental regulations.	Rooks and Oerlemans 2005
2	South African companies that combined internal strategies and external knowledge had improved their market position compared to other innovative South African companies.	Oerlemans and Rooks 2005
3	The 2005 South African Innovation Survey identified that the acquisition of equipment and software accounted for the majority of innovation activity (internal process innovation).	Blankley 2007
4	Called for the development of skills in design, engineering, entrepreneurship and management.	OECD 2007, 2011
5	International partnerships are beneficial to innovation at South African companies.	Bakker et al. 2008
6	Called for better understanding of innovative South African companies, organisational routines, processes and drivers of innovation.	Lorentzen 2009
7	South African companies demonstrated reluctance to venture into the unknown or to experiment with technology and business models.	Blankley and Moses 2009
8	Called for the development of an educational curriculum teaching the process of innovation in South African institutions.	Blankley and Booyens 2010
9	Called for innovation policy development that focused on company-level business skills development.	Booyens 2011
10	According to the 2008 South African Innovation Survey, only 27% of innovative companies successfully introduced innovations to the market place.	Moses et al. 2012
11	The South African National Development Plan 2030 (NDP 2030) places education, training and innovation as central tenets to tackling poverty.	National Planning Commission 2012
12	The South African Labour Market Intelligence Partnership emphasised that the development of skills at all levels within businesses was important for innovation.	Gastrow 2012
13	Called to strengthen innovation through human capital and skills development in universities in the southern African region.	Kumar and Bergstrom 2013
14	The South African National Advisory Council on Innovation (NACI) developed a key policy framework area for the commercialisation of know-how in which the role of business is central to successful innovation.	NACI 2015
15	The study confirmed an increase in technology-driven product and service exports from South Africa.	Mathee et al. 2016
16	The study confirmed that current high rates of unemployment in South Africa negatively affect innovation in the country.	Daniel 2017
17	The study identified that the behaviour of leaders in Southern African organisations did not focus on nurturing and supporting innovation.	Grobler and Singh 2018

Table 6: Recommendations for further study of innovation in South Africa

The second grouping of academic research specifically developed new theoretical understanding of innovation in the South African business context. As innovation in South Africa is a broad topic, this review has only searched and reviewed theory that is

specifically relevant to the innovation process, the interplay between the organisation and individuals within the organisations, and their links to the external environment. Reviewing the literature on organisations, individuals and their external business environment uncovered what is known about the *means* and *social context* attributes of innovation in South Africa (Table 6).

Group 2: Academic research resulting in new understanding and theory of innovation in South Africa (Organisational/Individual/Environment)		
1	Entrepreneurial orientation is linked to company success in South Africa.	Urban 2008
2	The metacognitive abilities of entrepreneurial intentions were linked to successful innovation in South African companies (especially the Knowledge dimension of metacognition).	Urban 2012
3	Strategic corporate entrepreneurship in South African companies requires internal support and external opportunities from the business environment.	De Villiers-Scheepers 2012
4	Strong entrepreneurial orientation in South African companies is a predictor of product and service innovation success.	Urban 2013
5	Entrepreneurial activity in South African companies is achieved by linking organisational building blocks to individual entrepreneurial alertness and metacognition.	Urban and Wood 2017

Table 7: Existing theory of innovation in South African companies

The review of innovation policy in South Africa (OECD 2007: 149-182) specifically discussed and devoted an entire chapter to the role of “business enterprises in the innovation system”. The review emphasises the essential role of design, engineering, entrepreneurial and associated management activities, claiming that many South African companies rely solely on these capabilities for innovation (OECD 2007). The three key roles played by design, engineering, entrepreneurship and management are firstly the generation of specifications for the production of products and services. Secondly, design, engineering, entrepreneurship and management played a central role in translating knowledge acquired from internal and external research and development sources. Thirdly, design, engineering, entrepreneurship and management actively seek out knowledge from research and development suppliers when current knowledge is inadequate to concretise specific technical configurations and performance requirements for the innovation project. The OECD (2007) report points out that global economic change has led to dispersed innovation processes and this trend is also observed in South African companies. Dispersed innovation processes imply that not all capabilities necessary for innovation are internal to the company. Like their international counterparts, South African companies implement innovation through networks. The design, engineering, entrepreneurial and management capabilities in South African companies are essential to the exploitation of innovation networks required to achieve innovations within the companies (OECD 2007). The OECD (2007) report raises concerns about the lack of design, engineering, entrepreneurial and management skills

needed to take advantage of innovation opportunities, and refers to these shortages as the looming crisis (OECD 2007).

Urban (2008) set out to determine the prevalence of entrepreneurial orientation in a diverse array of South African companies, as previous research on entrepreneurial orientation excluded the sub-Saharan African region. The results of this study confirmed a strong relationship between entrepreneurial orientation and commercial success of South African companies. This study specifically recommends that strengthening entrepreneurial orientation of existing South African companies, as opposed to only encouraging individuals to become entrepreneurs to start new businesses, is essential to building and encouraging a strong and successful entrepreneurial ethos in the country.

In the “metacognitive approach to explaining entrepreneurial intentions”, Urban (2012: 16) argued that the metacognitive dimensions of goal orientation, metacognitive knowledge, metacognitive experiences, metacognitive choices and metacognitive monitoring were predictors of entrepreneurial intentions in the South African context, although the findings only supported the knowledge metacognitive dimension of individuals as a significant predictor of entrepreneurial intention. Metacognition is described as a higher order cognitive process in which individuals are able to understand themselves, their tasks, situations and environments in order to think and act effectively with the feedback received from complex dynamic environments (Urban 2012). Individuals who act in a metacognitive manner are able to respond to stimuli using multiple different decision frameworks, pose alternative solutions, be receptive to feedback from their environment and incorporate this feedback into subsequent decision frameworks. The study by Urban (2012) demonstrated that metacognitive behaviour, especially in the knowledge dimension, was integral to the entrepreneurial intention of individuals in the South African context.

In the South African emerging economic context, entrepreneurial intensity or innovation was found to be strongly related to internal organisational support and external environmental opportunities (De Villiers-Scheepers 2012). This study determined that management support, autonomous employees and rewards from the organisation were necessary internal requirements to support entrepreneurial intensity. The perception of external environmental opportunities resulting from market dynamics, technological opportunities and demand for new products were determined to be necessary external requirements in the South African emerging economic context (De Villiers-Scheepers 2012). This study noted that the ways in which internal organisational support and the external environment influenced entrepreneurial intensity had received limited attention

from the academic research community. This study also called for further investigation to understand the role of individuals within the process of strategic corporate entrepreneurship.

The work of Urban (2013) found that the entrepreneurial orientation of South African companies was a strong predictor of product innovation. The study, which was confined to the study of the health insurance and health care industries, confirmed that South African health insurance companies that exhibit entrepreneurial behaviours in their processes, practices and decision-making demonstrated successful product innovation.

A recent article by Matthee, Idsardi and Krugell (2016) confirmed that non-fuel primary commodities, medium-skilled and technology-intensive product exports had increased, while resource-intensive manufacture exports had decreased. However, the lack of a sufficient supply of skilled labour such as design, engineering, entrepreneurship and management continued to hamper strong growth of non-fuel commodities, medium-skilled and technology-intensive products and services.

Job creation and economic growth in South Africa was analysed over the period of 2008 to 2016, and the investigation found a significant growth in joblessness since 2008 (Daniel 2017). The analysis confirmed that South Africa has one of the highest rates of unemployment and found links between low levels of employment and economic growth (Daniel 2017). The study recommended the relaxation of strict labour regulations, accelerated skills training and development, the fostering of entrepreneurship for individuals and the prioritisation of entrepreneurs in companies.

Urban and Wood (2017) were able to prove, using structural equation modelling, that corporate entrepreneurship in South African companies combines the behaviours and interactions of individual staff members with various organisational factors. Their model found that organisational factors such as management support, structural support, rewards, organisational boundaries and resources interacted with individuals through their entrepreneurial alertness and metacognition, leading to corporate entrepreneurial activity. Their study confirmed that innovation in established South African companies is a multi-dimensional phenomenon that combines corporate entrepreneurship across both organisational and individual level factors. Their hypothesis posited that the integration of building blocks (organisational level), entrepreneurial alertness and metacognition (individual level) led to corporate entrepreneurship activity (Figure 8).

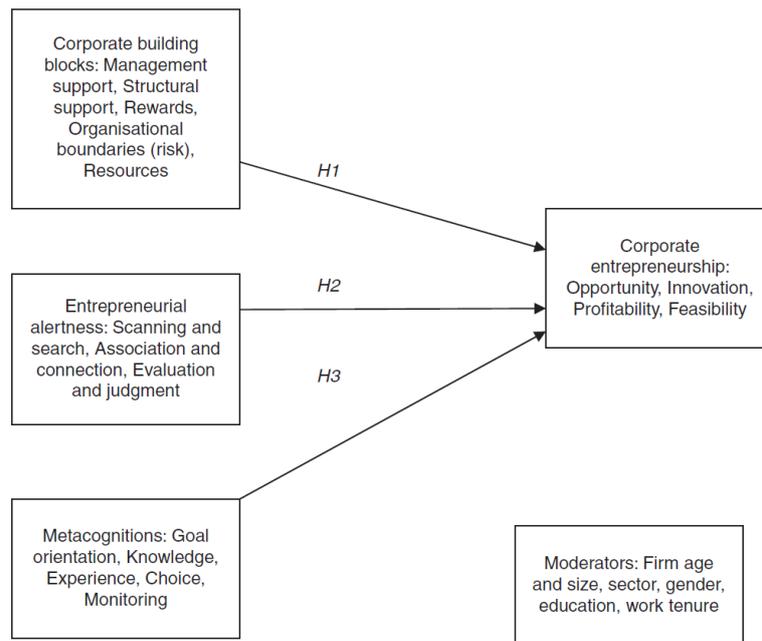
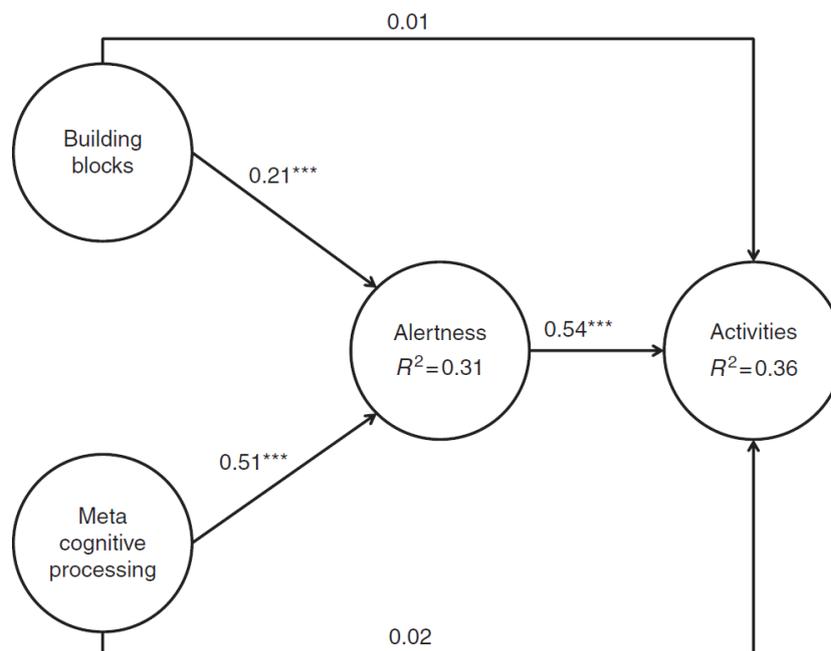


Figure 8: Research hypothesis of Urban and Wood (2017: 540)

The results supported the claims that corporate building blocks, alertness and metacognition led to corporate entrepreneurship activities in South African companies (Figure 9).



Notes: Paths are standardized β s. *** $p < 0.01$

Figure 9: Model for corporate entrepreneurship in South Africa (Urban and Wood 2017: 550)

Urban and Wood (2017) pointed out that these essential variables provided an introductory guide to further research that investigated the interaction of contextual,

cognitive and behavioural variables for corporate entrepreneurship in the under-researched South African context.

The study by Grobler and Singh (2018) compared organisations leadership behaviour in Southern Africa with organisations leadership behaviour in North America based on the taxonomy developed in the United States of America by Yukl, Gordon and Taber (2002) and Yukl (2012). This organisational leadership behaviour taxonomy presented four meta-categories namely; task-orientated behaviours, relational-orientated behaviours, change-orientated behaviours and external leadership behaviours. Yukl (2012) advised that this leadership taxonomy did not represent a final all-encompassing solution. Instead he maintained that different contexts in which the taxonomy was applied may lead to alterations and adaptations to the meta-categories that were presented in the North American context. By applying Yukl et al. (2002) and Yukl's (2012) organisational leadership behaviour taxonomy to Southern African leaders Grobler and Singh (2018) were able to observe significant adaptations to the North American presentation of the meta-categories. Grobler and Singh (2018) identified a new African meta-category not observed to be of significant influence in the North American context. The African meta-category put forward by Grobler and Singh (2018) described how the behaviour of Southern African leaders exhibited a far greater participatory, democratic and communalistic focus when compared to the behaviour of North American leaders. Furthermore, Gobler and Singh (2018) found several notable exclusions when compared to North American leadership behaviour namely; client focus, innovation and individual performance management were missing from the behaviour of Southern African leaders.

The exclusion of client focus and innovation behaviours in Southern African leaders in particular is cause for concern as both these behaviours are essential to creating and maintaining competitive advantage of the organisation as argued by Lorentzen (2009), Govindarajan and Trimble (2010) and Urban and Wood (2017). The call to understand innovation in South African companies by Lorentzen (2009), the link between organisational support and individual staff members metacognitive capabilities to drive entrepreneurial activities in South African companies established by Urban and Wood (2017) and the lack of client focus and innovation behaviour of Southern African leaders identified by Grobler and Singh (2018) present the extent of the gap in understanding for the role leadership plays in successful innovation projects that create and maintain competitive advantage in South African companies. Investigating successful individual South African innovation leaders is intended to contribute to understanding the underpinning principle, processes and organisational leadership behaviour required to support innovation that led to new competitive advantage for the company.

The literature review on the current state of understanding and theory for innovation in South African companies presents a picture of limited understanding and theory development when compared to the understanding and theory developed in Western economies such as the United States of America and Western European countries. Using the understanding and theory that has been developed in South African companies along with established international theories, this study attempts to develop a deeper understanding of the how South African innovation leaders/corporate entrepreneurs use organisational support, their entrepreneurial capabilities and the external opportunities provided by their environment to successfully develop new innovative products and services.

In summary, understanding the post-apartheid innovation landscape through what has been achieved with policy and surveys in the recent past helps build an understanding of the shortcomings of innovation in the South African environment. This includes the lack of understanding of how South African companies innovate successfully and offer new competitive advantages. Understanding the local conditions also demonstrated a willingness by South Africans to embrace innovation in both the private and public sectors. Policymakers are actively investigating eight policy framework development areas. The private sector is actively investigating innovation and seems willing to use innovation as a strategy to remain competitive. It is plausible that these principles common to the leadership of all innovation activities in established businesses studied in North America are also common to innovation in South African companies. This literature review has not identified any research that has investigated these principles in South African companies. Developing an understanding of how these leadership principles impact on innovation activities in South African businesses is intended to provide answers on how South African innovation leaders succeed in the local socio-economic context.

2.4 Existing models of innovation leadership

This section reviews existing models of innovation leadership. The discussion begins by making a comparison between innovation leadership models that resulted from academic research, and innovation leadership models that resulted from industry experiences. The discussion continues by reviewing the academic models in greater depth. In subsection 2.4.1, models that investigate the behaviours of individuals who lead innovation are discussed. In subsection 2.4.2, models of the innovation process over time are reviewed, culminating in showing how these models that focus on the innovation process at the organisation level contribute and combine with models that focus on the innovation leader at the level of the individual, as presented in subsection 2.4.3.

In reviewing innovation leadership models, two clear categories emerged, namely models that are the result of academic research and models based on the experiences of individuals or small groups practising innovation in industry. The academic models attempt to describe underlying reasons that are generalisable to any organisation using a scientific method to prove their validity and reliability. By contrast, models developed through experience in the field tend to be specific to a particular business environment or industry. Innovation leadership models developed through experiences do not require a scientifically rigorous method to prove their validity or reliability. These anecdotal models are not discussed in detail in this review, because it is difficult to determine their validity and reliability. This review nevertheless acknowledges that anecdotal models exist and do have an impact on the practice of innovation leadership. This is partly due to their ease of access through the internet, and partly due to the fact they are packaged in simple language with graphical elements that are easy to understand.

2.4.1 Innovation leadership characteristics

Models for innovation leadership that stem from academic work tend to focus on the behaviour and cognitive abilities of innovation leaders and how companies can implement innovation leadership.

Roscorla (2010: 1) argues that the behaviour model of innovation leaders should be to:

- “Embrace challenges”
- “Drive change through collective creativity and knowledge”
- “Shape the culture of the organisation”
- “Establish a professional learning system”
- “Decide and systematise”
- “Ensure digital access and infrastructure”
- “Demand accountability”

Carmeli, Gelbard and Gefen (2010: 341) propose the following innovation leadership behaviours:

- “Encouraging individualisation initiatives”
- “Clarifying individual responsibilities”
- “Providing clear and complete performance evaluation feedback”
- “Maintaining strong task orientation”

- “Emphasising group relationships”
- “Demonstrating trust in organisational members”

Shavinina (2011: 165-185) developed a model to explain the mental cognitive requirements of innovation leaders, which included:

- “A developmental foundation of innovation leadership”
- “The cognitive basis of innovation leadership”
- “Intellectual manifestations of innovation leadership”
- “Metacognitive manifestations of innovation leadership”
- “Extra-cognitive manifestations of innovation leadership”

The work of Vlok (2012: 219-222) attempts to develop a profile to describe South African innovation leaders based on their competencies, namely:

- “Strategist”
- “Capacity builder”
- “Match maker”
- “Achiever”

The work of Horth and Vehar (2014: 10) suggests three broad areas:

- “A tool set”
- “A skills set”
- “A mind set to help innovation leaders achieve success”

The work of Lindgren and Abdullah (2013: 128) proposes a model that companies can use to implement innovation leadership by defining:

- “The task of innovation leadership”
- “The field of innovation leadership”
- “The success criteria for the company’s innovation leadership task”
- “The model of innovation leadership used in the company”
- “The process of innovation leadership”

The model of leading for innovation developed by Hunter and Cushenbery (2011: 250) spans multiple levels of creativity, namely individual, team and organisational levels.

They argue that innovation leaders perform a multitude of roles in a non-linear process across multiple levels within the organisation (Figure 10).

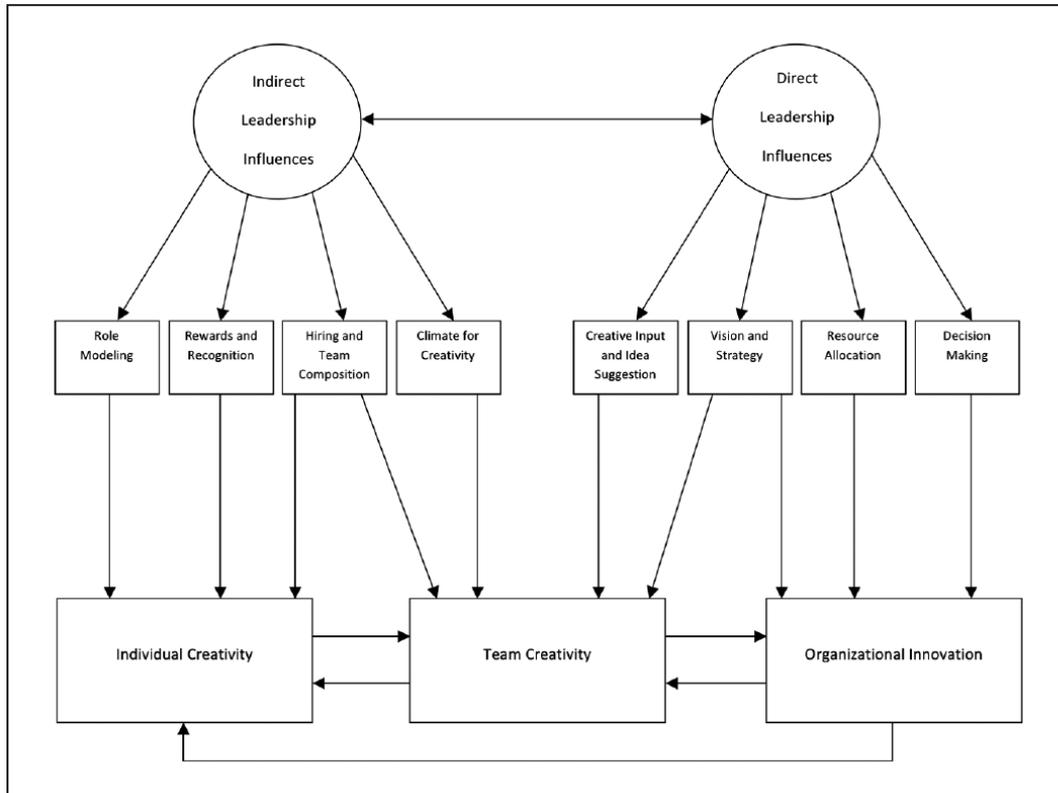


Figure 10: Innovation leadership model (Hunter and Cushenbery 2011: 251)

Weberg (2013) maintains that innovation leadership matches complexity theory and argues that previous leadership theories lack the complexity required for innovation leadership. Weberg's (2013: 62-69) work identifies seven characteristics of innovation leadership:

- “Boundary spanning”
- “Risk taking”
- “Visioning”
- “Leveraging opportunities”
- “Adaptation”
- “Coordination of information flow”
- “Facilitation”

These models contribute to understanding the behaviours of innovation leaders, which is beneficial in adding to the theories about leadership. Weberg (2013) points out that

current leadership theory struggles to explain innovation leadership due to the complex nature of this type of leadership. He proposes that complexity theory will help explain innovation leadership. Understanding the behaviour of innovation leaders can assist companies and human resource practitioners to identify and select people who exhibit the behaviours shown to be of value for innovation initiatives.

This study does not focus on the behavioural and cognitive traits of innovation leaders. The models presented above in this subsection demonstrate that behavioural and cognitive traits have received attention from the academic research community. In contrast, the present study investigated the principles and processes of individual innovation leaders that apply to all innovation initiatives regardless of the behavioural and cognitive traits of specific innovation leaders. This study investigated how contextual differences present in the emerging economy of South Africa affect these principles and processes. This was done in order to develop a model that better suited the South African emerging socio-economic context. The lack of models presented in the literature review that deal with innovation leadership principles in emerging socio-economic contexts implies that there is an insufficient understanding of innovation leadership principles in these contexts (Rooks and Oerlemans 2005; Blankley and Moses 2009; Blankley and Booyens 2010; Booyens 2011).

2.4.2 Organisations innovation processes

The way in which the innovation processes that companies follow (organisation level) and the role that innovation leader plays (individual level) in their company's innovation process are combined is an emerging field of study (McFadzean et al. 2005; Govindaranjan and Trimble 2010). This subsection firstly describes the innovation process used by organisations and how it has evolved over time, followed by a review of the literature that attempts to describe how individual innovation leaders contribute to the evolving innovation process in subsection 2.4.3.

From the 1950s until the mid-1960s, advanced economies such as those in North America and Western Europe experienced rapid growth through industrial expansion (Rothwell 1994). New industries emerged based on a broad range of new technological opportunities, such as new composite and synthetic materials, pharmaceuticals, electronic computing and semi-conductor development. The focus of manufacturing companies was to use research and development (R&D) to create new products using these technologies to service the growing demand (Rothwell 1994).

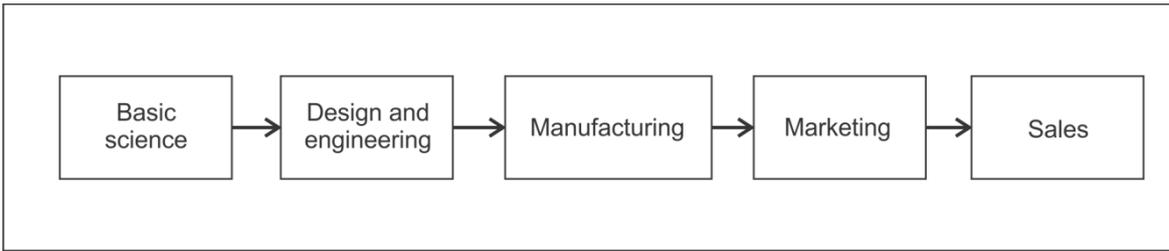


Figure 11: First generation innovation process (Rothwell 1994: 8)

This first generation innovation process was described as a linear process “[f]rom scientific discovery, through technological development in firms, to the market place.” (Rothwell 1994: 8). Rothwell described this as the “technology push” form of innovation, placing emphasis on the notion that increased R&D effectively led to greater success for new product output. The “technology push” approach gave very limited attention to the technology development process and the role of consumers in the marketplace in this first generation innovation process (Rothwell 1994: 8), as shown in Figure 11.

The first generation innovation process brought about new industrial expansion driven by new technological developments. By the mid-1960s, the focus started to move away from new technological developments to using these existing technologies to introduce new products with incremental improvements (Rothwell 1994). This second generation innovation model was described as the “Market Pull” model (Rothwell 1994: 9), as shown in Figure 12. During this period, the focus shifted to corporate growth and diversification in manufacturing firms driven by marketing. Rothwell (1994) reported that this approach exposed firms locked into incremental technological improvements to loss of market share from new or radical technological change introduced by competitors.

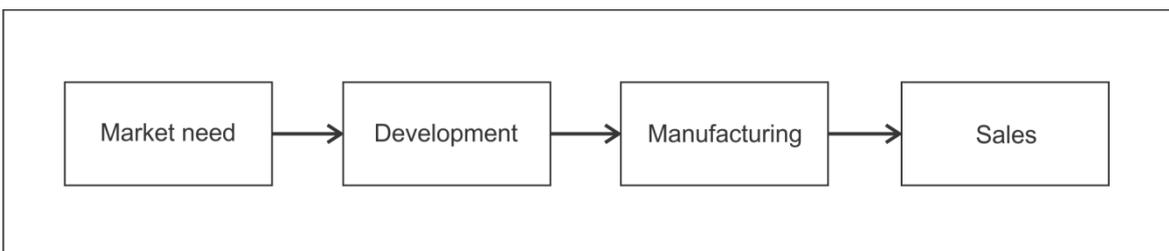


Figure 12: Second generation innovation process (Rothwell 1994: 9)

From the 1970s until the mid-1980s, the economic context of advanced Western economies included high inflation, saturation of demand for new products, oil supply crises, growing unemployment, consolidation, cost control and cost reduction. Academic research on innovation focused on understanding successful innovations in order to minimise the occurrence of wasteful unsuccessful innovation projects. The results of empirical studies during this period concluded that the “technology push” and “Market

Pull” models of innovation were infrequent extreme outlier forms of the more frequent balanced interaction between technological capabilities and market needs (Rothwell 1994). The third generation innovation process model shown in Figure 13 blended both technological advances and market needs in a sequential manner using interdependent steps that communicated across internal and external stakeholders (Rothwell 1994). Rothwell (1994: 10-11) identified important factors that he divided into two groups, namely project execution factors and corporate level factors.

“Project execution factors”:

- “Good internal and external communication: accessing external know-how.”
- “Treating innovation as a corporate-wide task: effective inter-functional coordination, good balance of functions.”
- “Implementing careful planning and project control procedures: high-quality up-front analysis.”
- “Efficiency in development work and high-quality production.”
- “Strong marketing orientation: emphasis on satisfying user needs, development emphasis on creating user value.”
- “Providing a good technical and spares service to customers: effective user education.”
- “Effective product champions and technological gatekeepers.”
- “High-quality, open-minded management: commitment to the development of human capital.”
- “Attaining cross-project synergies and inter-project learning.”

“Corporate level factors”:

- “Top management commitment and visible support for innovation.”
- “Long-term corporate strategy with associated technology strategy.”
- “Long-term commitment to major projects (patient money).”
- “Corporate flexibility and responsiveness to change.”
- “Top management acceptance of risk.”
- “Innovation-accepting, entrepreneurship-accommodating culture.”

An important outcome of Rothwell’s (1992) study was that innovation successes or failures were unlikely to be attributable to just one or two of these factors. The reasons for success or failure were most often multi-factored. Rothwell (1994: 11) implied that successful innovation was the result of “doing most tasks completely and in a balanced

and well co-ordinated manner”. He argued that “key individuals of high quality and ability; people with entrepreneurial flair and strong personal commitment to innovation” were at the heart of successful innovation projects (Rothwell 1994: 11).

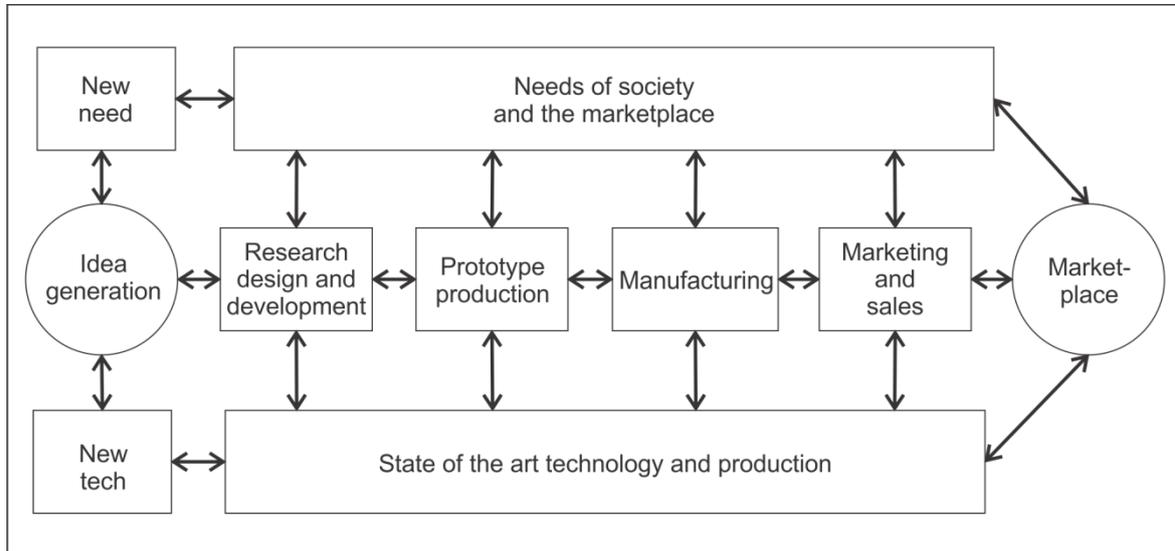


Figure 13: Third generation innovation process (Rothwell 1994: 10)

By the early 1980s, improved economic growth in advanced Western countries led to companies using their core competencies in an increasingly strategic manner (Rothwell 1994). For example, companies focused on developing generic technologies to be applied to the emerging information technology-based manufacturing equipment. These developments encouraged alliances between companies and external networking with suppliers and other stakeholders, leading to the emergence of global strategies (Rothwell 1994). These alliances and external networking activities led to shorter product development cycles. Japanese companies were acknowledged to provide noteworthy examples of the fourth generation innovation model, which included integration and parallel development with suppliers and inter-company alliances, as shown in Figure 14 (Rothwell 1994). Product development integrated external parties with multiple internal departments simultaneously (in parallel), as opposed to the sequential process followed in previous generation models. This integrated parallel process was described as “design for manufacture”, and Rothwell (1994: 12) put forth the innovation process used at the Nissan Corporation as a noteworthy example of the fourth generation innovation model.

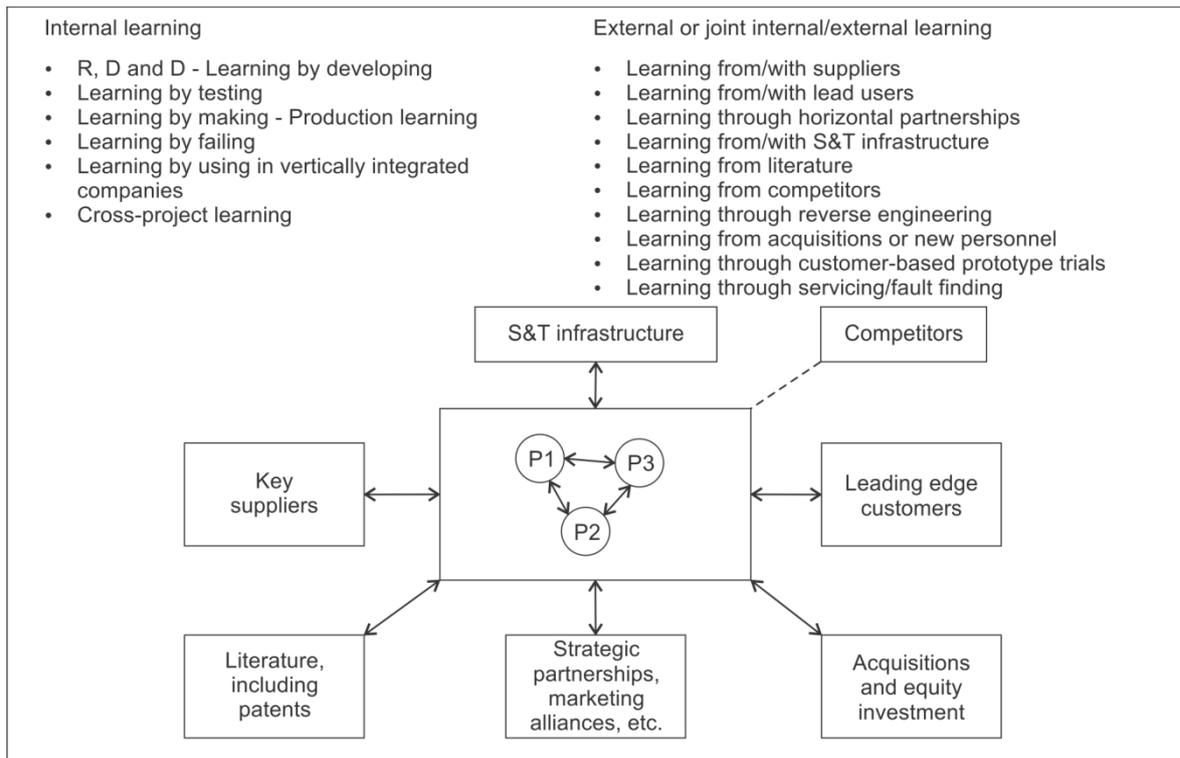


Figure 15: Fifth generation innovation process (Rothwell 1994: 27)

The model describing the open innovation process was introduced by Chesbrough (2012), who argued that the traditional model of innovation that only used the company's internal capabilities and resources to offer new products and services to the marketplace was closed innovation. The closed innovation model was used successfully in the late twentieth century, but Chesbrough (2012) discovered in the 1990s that some companies did not practise closed innovation. For example, he observed how Cisco, which had hardly any internal research and development capabilities, managed to stay abreast of their direct competitor Lucent, which successfully invested heavily in internal research and development activities. Instead, Cisco surveyed the world for innovative small start-up companies with promising technologies (Chesbrough 2012). Cisco invested, partnered and/or acquired these start-up companies as their technologies gained traction. Chesbrough argued that Porter's work accurately described the closed innovation process, but not what was observed at companies such as Cisco. Using numerous examples similar to Cisco, Chesbrough (2012) demonstrated open innovation. Chesbrough (2012: 21-25) describes two forms of open innovation, namely outside-in and inside-out.

In closed innovation, projects entered through the science and technology base of the company went through a process of development and exited the company by being introduced to the company's marketplace, as shown in Figure 16.

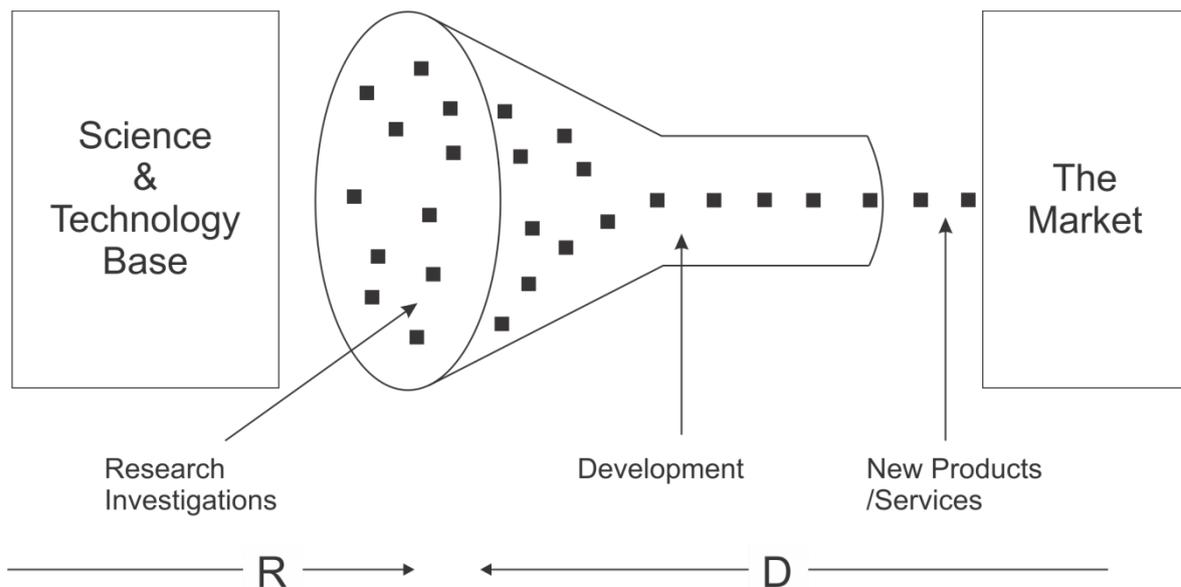


Figure 16: Chesbrough's representation of closed innovation (Chesbrough 2012: 22)

In open innovation, by contrast, projects can enter or exit at various stages and do so in more than one way, as shown in Figure 17. Projects may stem from external sources as well as internal sources and may use technology building blocks sourced from many different external sources. Open innovation projects may also exit at different points of the process in different ways, rather than only exiting the company to be sold in the company's current marketplace. Open innovation projects could take the form of licences to other companies, or new companies formed as spin-offs to pursue the value of the new technology. Outside-in innovation project receive inputs from various external and internal sources and are presented to the company's marketplace through the internal marketing process. Inside-out innovation projects, by contrast, go to market using external methods such as "out licensing" or "technology spin-off" instead of the company's internal marketing process (Chesbrough 2012: 21-25). Open innovation is beneficial in that it provides greater access to technologies, and reduces development time and cost by including external sources. Open innovation provides broader opportunities for dormant intellectual property owned by the company that does not fit the company's business model and marketplace. Dormant intellectual property can create value through making it available to others for licensing or use in new spin-off companies.

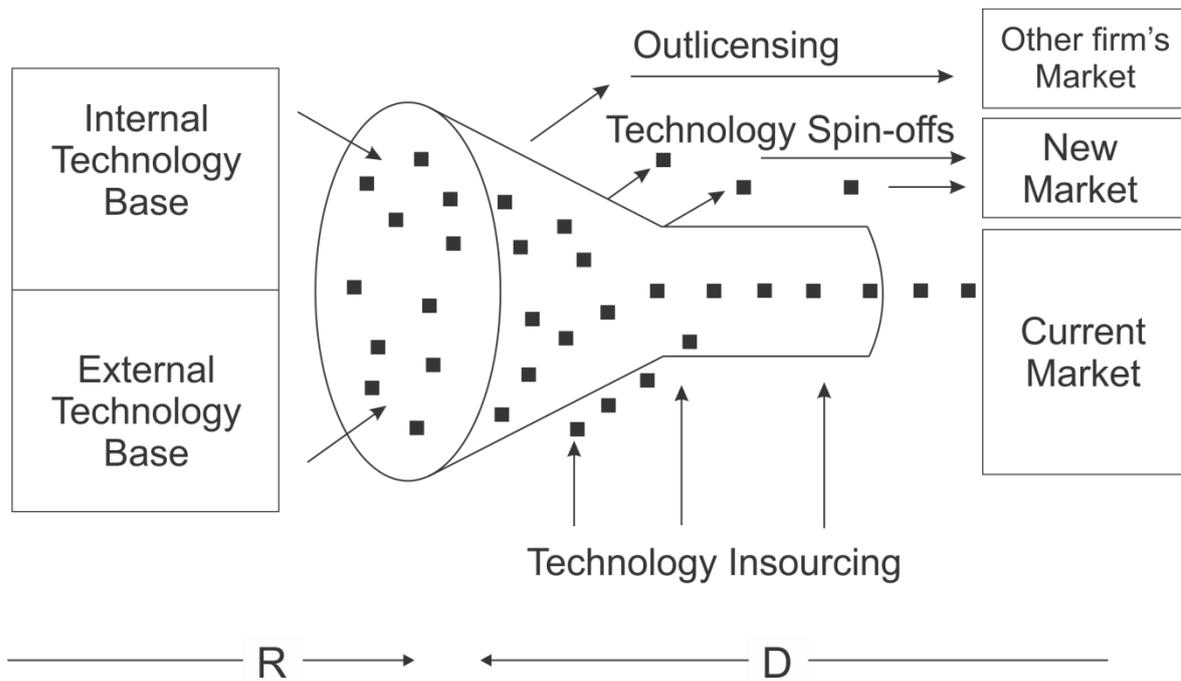


Figure 17: Chesbrough's open innovation model (Chesbrough 2012: 23)

2.4.3 Combining innovation processes and leaders

The work of McFadzean et al. (2005) developed a combined definition and multi-level model to explain the links between corporate entrepreneurs and the innovation process. They found that the gap between corporate entrepreneurs and the innovation process can be explained by the following three factors; entrepreneurial attitude, vision and actions (McFadzean et al. 2005). Corporate entrepreneurs are individuals who drive the innovation process within their companies.

Understanding the entrepreneurial attitude, they argued, was one of three essential factors in the link between the corporate entrepreneur and the innovation process. McFadzean et al. (2005) maintained that important factors such as economic circumstances, entrepreneurial teams, social networks, finance, marketing and public agency support, for example, could not create new innovative ventures without a responsible committed person, namely an individual in whose mind the possibilities for innovation come together; in other words the corporate entrepreneur or innovation leader with the prerequisite entrepreneurial attitudes to challenge conventions and encourage innovation by examining a broad range of interrelated factors (McFadzean et al. 2005).

Understanding entrepreneurial vision, they argued, was another essential factor linking the corporate entrepreneur to the innovation process. The entrepreneurial vision allowed for the combination of what the company wished to achieve in the future and the

visualisation of the potential opportunities that the environment provided as potential synthesis in the mind of the corporate entrepreneur (McFadzean et al. 2005).

The third essential factor that entrepreneurial action builds on is entrepreneurial attitude and vision by putting into action the envisioned possibilities. McFadzean et al. (2005) argued that entrepreneurial action consisted of social interactions that integrated the internal and external environments of the company. The entrepreneurial actions included resource management, organisation, the ability to influence and generate support from others and the ability to assess, shape and develop ideas. They described the combination of entrepreneurial attitude, vision and actions as the essential catalyst that linked the corporate entrepreneur to the company's innovation process.

In part two of the work, Shaw, O'Loughlin and McFadzean (2005) presented a holistic model of corporate entrepreneurship and innovation, as shown in Figure 18. The model was presented in two separate levels, namely the macro level and micro level. The macro-level model considered the context of the corporate entrepreneur and the company's innovation process; in particular the environmental drivers of innovation previously identified as technology push or market pull.

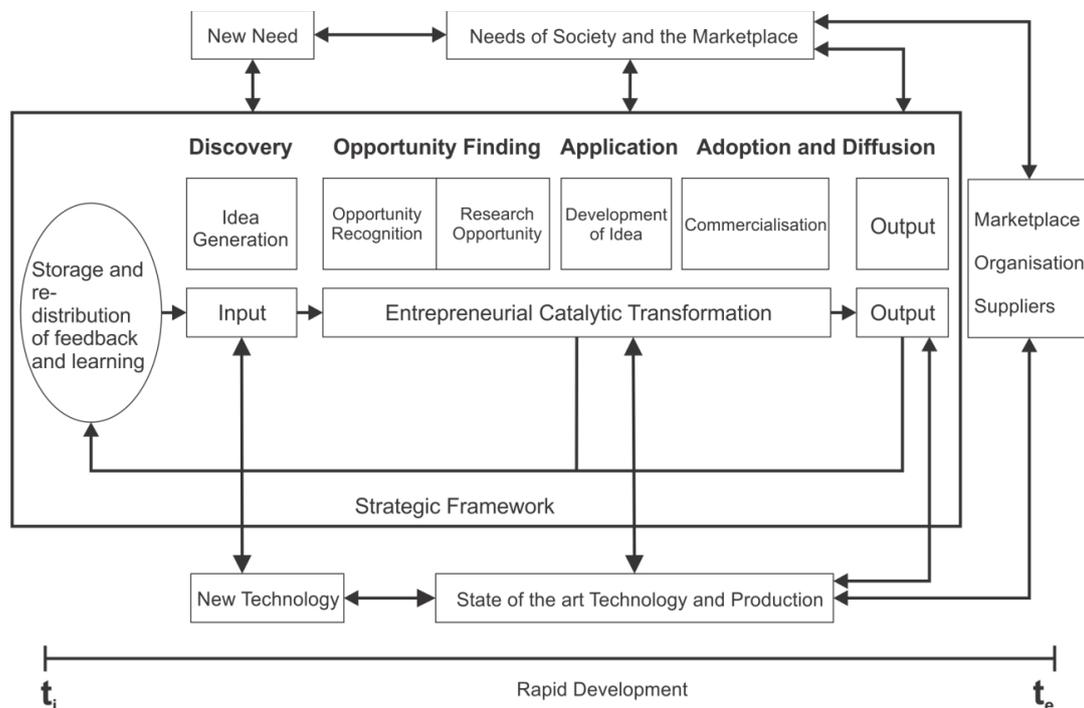


Figure 18: Macro-level model (Shaw et al. 2005: 395)

The micro-level model focused on the factors that underpinned the corporate entrepreneur and the company's innovation processes, namely inputs, entrepreneurial

catalyst transformation, output, contextual factors and the relationships between the different elements of these factors, as shown in Figure 19 (Shaw et al. 2005).

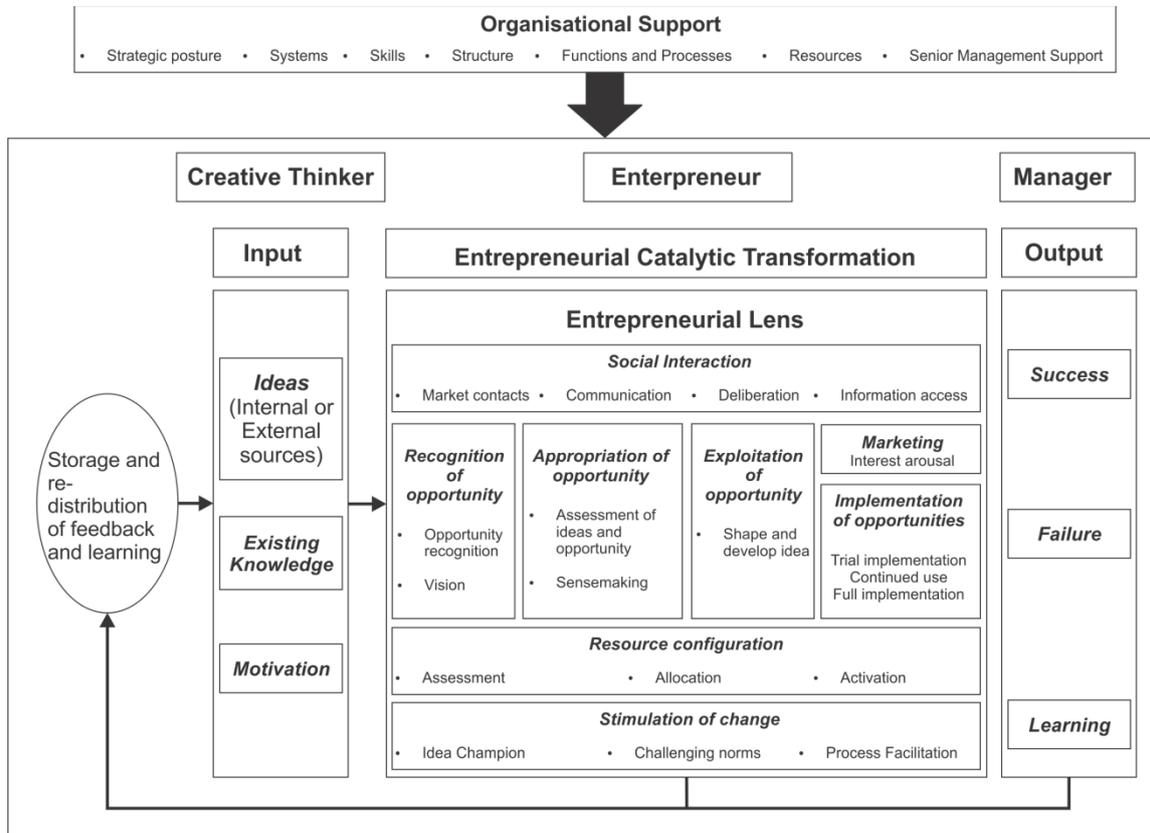


Figure 19: Micro-level model (Shaw et al. 2005: 397)

The work of Rothwell (1992, 1994) and Chesbrough (2010, 2012) in particular document and explain the progression of the innovation process over time. Rothwell's explanation of the innovation process begins in the 1950s with the first generation innovation process model and ends with the fifth generation model observed during the 1990s. In 2003 Chesbrough presented the open innovation model, which arguably builds on the preceding models presented by Rothwell. Each of the six innovation process models described by Rothwell (five models) and Chesbrough (one model) reflect on how the innovation process has changed over time, matching the understanding and capabilities of companies through the decades (1950–2000). From the 1950s to the 1990s, the prevailing *means* of innovation were the “technology push” and the “market pull”, starting with the “technology push” of the 1950s, which was later replaced with the “market pull” *means* of innovation. The fifth generation innovation process model (Rothwell 1994) and the open innovation model (Chesbrough 2012) have described the emergence of a new *means* of innovation that is not yet fully understood or definitively described. Currently this *means* of innovation can be described as collaborative, network or open source innovation (Chesbrough 2012). The “technology push” *means* of innovation relied on

scientific advances, requiring an internal research and development team to create new products and services from scientific discoveries (Rothwell 1994). The “market pull” mean of innovation emerged as technologies matured and no longer changed or introduced new technology. The market demand required less scientific research and development resources and more market-facing resources that could understand market requirements and implement these in new products and services (Rothwell 1994).

Due to the need to improve the efficiency of the innovation process to achieve more with less and respond more rapidly to the ever-changing market conditions, large research and development teams and marketing departments in a growing range of business contexts were no longer sustainable. In response to these threats, companies have been observed to network and share intellectual property for mutual benefit (Rothwell 1994; Chesbrough 2012). The network *means* of innovation can be beneficial in that development cost are spread across multiple companies using the same intellectual property building blocks (Chesbrough 2012) to help each company achieve its innovation objectives. In order to understand how South African innovation leaders undertook successful innovation projects, the conceptual framework will include the three primary *means* of innovation, namely “technology push”, “market pull” and “network resource innovation”, in order to help determine the role of each of these *means* of innovation in the South African context.

The multidisciplinary definition of innovation (Baregheh et al. 2009) describes technology, ideas, inventions, creativity and market as the *means* (attributes) used in the innovation process. Rothwell (1994) placed greater emphasis on the technology and market *means* of innovation, as these were observed over time to play a primary role in how innovation (the *means*) was achieved. The conceptual framework of this study presents the *means* – technology, ideas, inventions, creativity, market and the emerging concept of networks resources – as being collectively necessary to the innovation process. This group of *means* all play a role in the innovation process; some play a small role, others a significant role, and one plays a primary role. The *means* concepts are best represented in a radar chart, as shown in Figure 20.

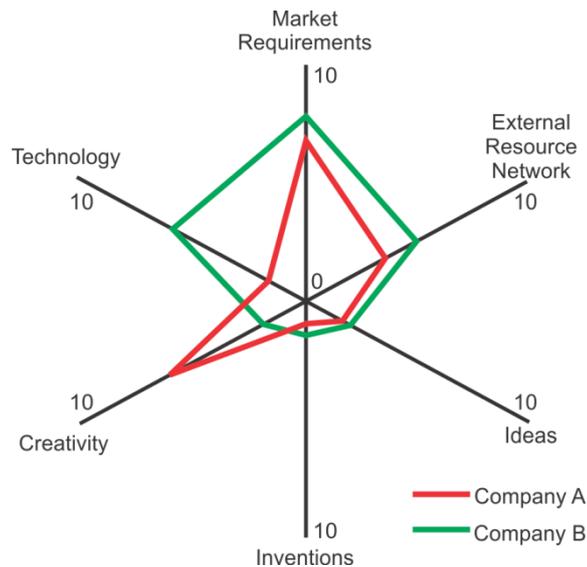


Figure 20: Radar chart representation of the *means* attribute Source: Author

This radar chart representation helps illustrate how to think about the *means* concepts of the innovation process. Each of the *means* concepts has a role to play in a bigger or smaller relationship to the other *means* around the central axis. The relationships between all the *means* concepts are not static, and the importance of each concept changes over time based on the company's internal and external context, as observed by Rothwell (1994) and Chesbrough (2012). Understanding which concept plays a primary role is important, as this understanding can guide the strategy that the company uses to successfully achieve innovation in an efficient manner (rapid and lean).

This study focuses on the role of South African innovation leaders in the innovation processes applied in their companies. Linking the role of innovation leaders to their companies' innovation processes has received limited attention from academic researchers (McFadzean et al. 2005; Govindaranjan and Trimble 2010). In 2005 McFadzean et al. (2005) presented two conceptual articles that examined the existing literature on corporate entrepreneurship and innovation with the aim of developing a combined definition of these two concepts. Their second article presented a multi-level conceptual framework based on the existing literature of corporate entrepreneurship and innovation. The work of McFadzean et al. (2005) helped guide the conceptual framework developed for this study by describing the missing link between the innovation leader and the innovation process. Entrepreneurial attitude, vision and actions define how the innovation leader is linked to the innovation process. The multi-level conceptual framework, titled the macro model and micro model, demonstrates that the innovation leader plays a significant role at both the macro and micro levels to move innovation projects forward. Over a ten year period between 2000 and 2010, Govindaranjan and

Trimble (2010: 3-4) conducted a longitudinal study to determine the role of innovation leaders in the “execution of innovation” projects in companies.

Unlike the theoretical nature of the studies conducted by McFadzean et al. (2005), Govindarajan and Trimble (2010) were able to empirically demonstrate five principles that innovation leaders used within their companies regardless of the size of the company or the nature of the innovation project. The empirical evidence and the resulting five principles are applied to the conceptual framework of this study to investigate the role of innovation leaders in South Africa. The shortcoming of the Govindarajan and Trimble (2010) study was that the principles focused on the micro-level internal processes that innovation leaders used. Their study did not focus on the link between the innovation leader and the macro level. The macro-level role is therefore guided by the works of McFadzean et al. (2005), Oerlemans et al. (2005), Chesbrough (2012) and Bruton et al. (2013). As these studies identified, innovation leaders played a significant role in the integration of the macro and micro levels of the innovation process.

2.5 Innovation process of individuals

This section discusses in more detail aspects that individual innovation leaders/entrepreneurs have contributed to the innovation processes at their companies. Previous empirical research on innovation leaders is discussed in subsection 2.5.1. In subsection 2.5.2 their contribution towards interaction with their company’s business environment context is presented. In subsection 2.5.3 their contribution to experimentation is presented. Subsection 2.5.3 also points out the individual leaders’ contributions to a positive relationship between ongoing operations and innovation initiatives (innovation paradox) and organisational structure (ambidextrous organisations) and refers to the subsections in the literature review where these concepts are covered in greater detail. Subsection 2.5.4 discusses how innovation leaders contribute to the planning of innovation projects, and subsection 2.5.5 discusses how leaders manage the composition and work of the innovation team.

2.5.1 Empirical research of innovation leaders

Numerous studies detailed in Appendix 1 were identified to have directly investigated innovation leaders in the business realm and are discussed under three headings: A) what the empirical studies investigated, B) which methodologies were used and C) what the findings revealed. The detailed table of empirical studies is presented in Appendix 1.

A. What the empirical studies investigated

Investigations of innovation and leaders in the business realm have contributed to the innovation process that they follow, which includes the following principles: the synthesis of internal and external learning, experimentation, organisational structure, planning, team composition and the relationship between innovation initiatives and the ongoing operations of the firm (McFadzean et al. 2005; Govindarajan and Trimble 2010; Urban and Wood 2017)

B. Which methodologies were used

Empirical research that investigated the principles that innovation leaders applied to innovation initiatives in established companies used a mix of quantitative and qualitative research methods. Five studies made use of quantitative methods to confirm a positive correlation between the variables under investigation. Eight studies made use of qualitative methods to gain a deeper understanding of how different principles are related to one another in a business setting. Two studies made use of a mixed methods approach in which both quantitative and qualitative data were collected and analysed to confirm the link between variables and to provide a deeper understanding of how these links work together.

C. What the findings revealed

Empirical studies of innovation leadership revealed principles that were important for leading innovation initiatives:

- a) Synthesis of internal and external learning (covered below in subsection 2.5.2)
 - The selection and balance of internal and external sources of learning.
 - Linking experimentation with the internal and external sources of learning, and driving the process to achieve the innovation objectives.
- b) Experimentation (covered in more detail in subsection 2.5.3)

The purpose of experimentation was to:

- Test new ideas in order to uncover and fix the flaws that are evident in a cyclical manner until the idea was rejected or put forth for commercialisation
- Create new knowledge for the organisation
- Provide a robust manner in which to measure new ideas

- Validate that customer needs were met; that the business model would extract value; and the way in which the solution would be produced and offered to the marketplace.
- c) Organisational structure (covered in more detail in subsection 2.2.5)
- Explorative organisational structures enabled exploration and were clearly different from exploitative organisational structures.
 - Transformational leadership styles were shown to fit best with exploration structure.
 - Creativity, openness, future orientation, risk-taking and proactiveness created the right organisational climate for innovation.
- d) Planning (covered below in subsection 2.5.4)
- A common innovation process known by all in the firm was required.
 - Planning strategy was informed by the need for new knowledge and organisational learning.
 - Planning for innovation differs from planning for ongoing operations.
- e) Team (covered below in subsection 2.5.5)
- A mix of capabilities was required, including staff who had responsibilities for ongoing operations, and dedicated innovation staff internal and external to the organisation.
 - The team fitted into the organisational structure and planning provided for innovation by the innovation leader.
- f) Relationship between innovation initiatives and ongoing operations (covered in more detail in subsection 2.2.1)
- The synthesis of internal and external learning, experiments for innovation, organisational structure, planning and team composition provided the evidence and dialogue to maintain a positive working relationship and a continued commitment to innovation.

2.5.2 Business environment context

The framework of strategic entrepreneurship in emerging economies developed by Bruton et al. (2013) described a set of variables, which they argued applied to innovation in emerging economic contexts. Included in this framework were a combination of micro-level processes and macro-level concerns that they maintained worked together to

produce positive performance outcomes for companies in emerging economic contexts (Bruton et al. 2013).

The Bruton et al. (2013) framework of strategic entrepreneurship in emerging economies presented the following variables: context, micro processes, macro processes, entrepreneurial activities and performance outcomes. Bruton et al. (2013) argued that entrepreneurial/innovative actions of emerging-economy companies were not uniform and were instead unique to their national context. They further argued that the national context plus the combination of micro-level processes and macro-level concerns relevant to the company created unique conditions linked to the specific emerging economy (Bruton et al. 2013). The variables of the framework of strategic entrepreneurship in emerging economies are presented in Figure 21.

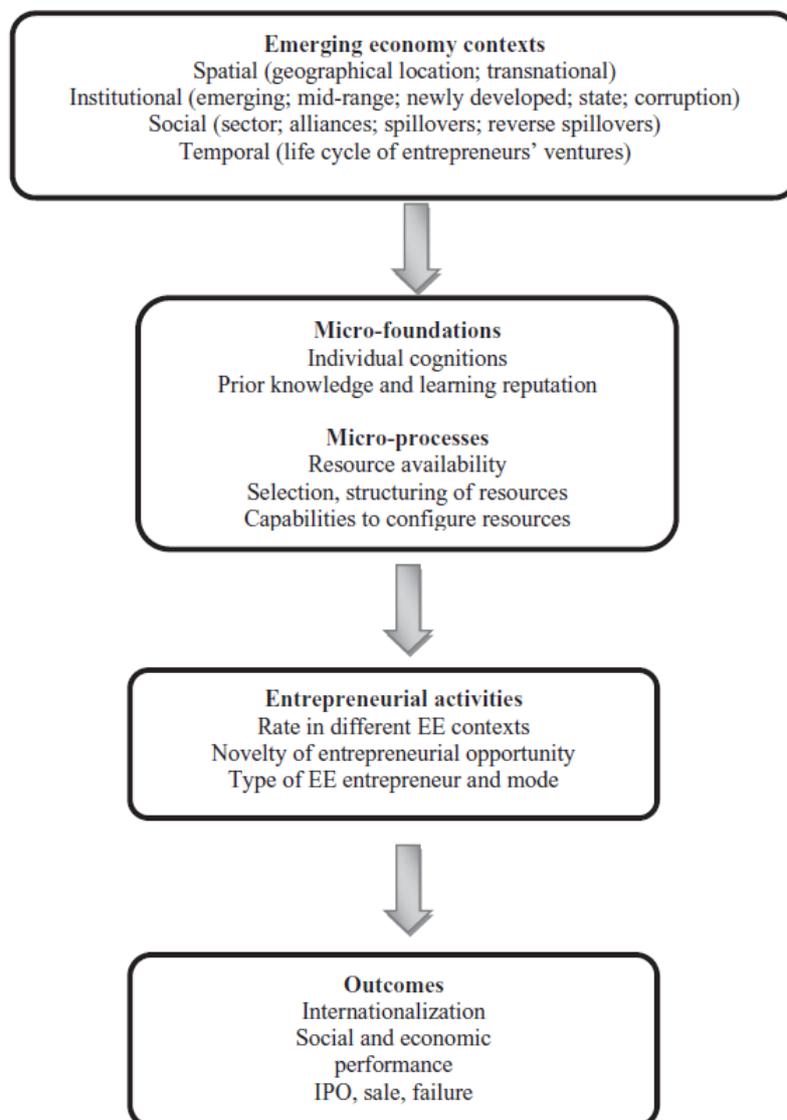


Figure 21: Framework of strategic entrepreneurship in emerging economies (Bruton et al. 2013: 172)

Emerging economy contexts

The context variable is described in the framework by four dimensions namely, spatial, institutional, social and temporal. The spatial dimension is concerned with the geographical concentrations and dispersions of companies and the institutions that support innovative companies (Bruton et al. 2013). The institutional dimension is concerned with the characteristics and types of institutions, such as financial, law and research, that support the efforts of innovative companies (Bruton et al. 2013). The social dimension is concerned with the relationships between parties such as sectorial configurations, universities and investors linked to innovative companies (Bruton et al. 2013). The temporal dimension is concerned with the life cycle of the company and how the current stage in the life cycle affects the company's innovation activities (Bruton et al. 2013).

Micro level

The micro level is divided into micro foundations and micro processes. The micro foundation describes the cognition and prior knowledge of individuals at the company such as innovation leaders and their teams and how their understanding is combined with their ability to learn and pose new solutions to problems (Bruton et al. 2013). The micro processes refer to resources available within the company and how these resources are selected and structured to aid the development of innovative ventures (Bruton et al. 2013). The collective cognition, prior knowledge and learning capabilities (micro foundations) are constrained and informed by the resources available to the company at the micro level (Bruton et al. 2013).

Macro level

The macro-environment concerns work together with the micro-level foundations and processes by selecting and utilising resources from the external macro environment in order to develop a set of resource capabilities that the company, its innovation leaders and teams exploit to capture new value for the company (Bruton et al. 2013). Macro-environment resources provided by partner networks include suppliers of components and raw materials; financial, law and research institutions; manufacturers; distribution networks; government agencies; industry bodies and many others that may exist and contribute in the specific emerging economic environment (Bruton et al. 2013). Khavul, Chavez and Bruton (2013) argued that the manner in which resources were combined and used in underdeveloped resource-scarce environments of emerging economies differed from the partner networks built in resource-rich mature economies. "Resources

are difficult to obtain in emerging economies, but which packages of resources to utilize and how to build those packages of resources in order to develop a competitive advantage through some capability becomes central to the entrepreneurial company success” (Bruton et al. 2013: 172).

Entrepreneurial activities

Entrepreneurial activities refer to dimensions that are key to understanding the variety of entrepreneurship/innovation in an emerging economy (Zahra and Wright 2011). These dimensions are rate, magnitude of novelty, and types of entrepreneurial activity (Zahra and Wright 2011). The rate refers to the number of new innovative ventures being created by the company at one time (Bruton et al. 2013). The magnitude of novelty describes the extent to which innovative solutions are new to the marketplace and the extent to which the knowledge contained in innovations is new or a combination of existing knowledge (Bruton et al. 2013). The type of entrepreneurial/innovative activity describes the vast potential range of knowledge sources through which new commercial opportunities may be identified (Bruton et al. 2013). For example; the prior knowledge of the innovation team, complaints from customers, and knowledge obtained from visiting other economies are a few examples of many possible sources of knowledge used for entrepreneurial/innovative activity (Bruton et al. 2013).

Outcomes

Outcomes refer to the performance outcomes achieved by innovation initiatives (Bruton et al. 2013). The performance outcome varies depending on the range of measurements chosen, such as financial or social impacts (Bruton et al. 2013).

This study in particular focuses on how innovation leaders created value through the process of innovation in the emerging socio-economic context of South Africa. The framework presented by Bruton et al. (2013) provides a broad understanding of four key variables associated with innovation in emerging economic contexts. This study specifically uses the variable of micro and macro processes to guide the development of the conceptual model for this study. The other variables (emerging economic context, entrepreneurial activities and performance outcomes), although relevant, fall outside the focus of this study and further development of the understanding of these variables is not considered here.

Bruton et al. (2013) argued that micro and macro processes needed to be combined to produce competitive advantage in the emerging economic context (Table 7). This notion

is supported by the findings of Oerlemans et al. (2005). In their study of innovative companies in South Africa, Oerlemans et al. (2005) found that companies that could combine their understanding of their internal strengths and weaknesses with an understanding of external strengths and weaknesses demonstrated improved market positions when compared to other innovative companies in a similar economic context. Their study specifically noted that if companies focused only on understanding either internal or external strengths and weaknesses, the effect on market position was negative, highlighting the importance of combining both internal and external audits of their strengths and weaknesses to achieve an improved market position. Understanding internal strengths and weaknesses was based on two complementary concepts, namely competence and capabilities. Competence referred to the collective learning integrating various skills and multiple technologies, while capabilities referred to a set of strategic business processes within the organisation. Understanding external strengths and weaknesses included the company's competitive market position and external technology trends. The competitive market position focused on the company's links to its customers and monitoring the actions of its competitors. The external technology trends required constant monitoring and engagement to ensure that the company was not left behind and could use its knowledge of emerging trends in technology to offer new competitive solutions.

Essentially, Oerlemans et al. (2005) and Bruton et al. (2013) have argued that a blend of internal and external processes located within the innovative company's economic context are required to create new value for commercial exploitation presented in Table 7. The variables of micro and macro processes are applied to the development of the conceptual framework for this study, as they provide contextually relevant guidelines for investigating how internal and external processes at the company level create successful innovative outcomes.

<p>Micro processes (Internal strengths and weaknesses) Individual company context</p>	<ul style="list-style-type: none"> - Individual cognition/understanding of problems - Prior knowledge/competencies - Learning through experimentation - Resources availability/strategic business processes
<p>Macro processes (External strengths and weaknesses) Company within its economic context</p>	<ul style="list-style-type: none"> - Selection and structuring of resources - Competitive market position and technology trends - Configure and use a blend of resources

Table 8: Micro and macro processes Oerlemans et al. (2005) and Bruton et al. (2013)

2.5.3 Innovation experiments

The seminal work of Govindarajan and Trimble (2010: 3-4) investigated how innovation leaders primarily in North American companies have succeeded in the “execution of innovation”. They undertook a ten-year longitudinal case study of companies (Table 8), which is detailed in their book, *The Other Side of Innovation: Solving the Execution Challenge* (Govindarajan and Trimble 2010),

<http://mba.tuck.dartmouth.edu/pages/faculty/chris.trimble/osi/research/index.html>

Company	Sector	Publication date
Nucor Corporation (A & B)	Steel manufacture	1998 and 1999
Stora Guso North America (SENA)	Paper industry	2001
Encyclopaedia Britannica (A, B & C)	Media publishing	2001
Wal-Mart Stores Inc	Retail stores	2002
Southwest Airlines Corporation	Domestic air travel	2002
New York Times Digital	Online media	2002
Hindustan Lever	FMCG manufacturer	2002
Dell Computer Corporation	Computer hardware	2002
Crown Point Cabinetry	Kitchen cabinet manufacturer	2002
3M Corporation	Manufacture	2002
Universitas 21 Global	Online higher education	2003
Corning Microarray Technology	Genomics	2003
Cisco Systems	End-to-end networking IT	2003
Capston-White	Document management devices	2003
Hasbro Interactive	Video and PC Gaming	2004
Infosys Consulting	Information technology	2006/2007
Thomson Corporation	Legal publishing	2007
Deere and Company	Tractor manufacture	2007
IBM	Computer hardware	2007
Don Jones and Company	Online Media	2007
Analog Devices Incorporated (ADI)	Electronics	2001, 2002 & 2007

Table 9: Case studies undertaken by Govindarajan and Trimble (2010)

Using grounded theory method to analyse the multiple case studies, Govindarajan and Trimble (2010) attempted to establish whether there are any common challenges to the leadership of innovation in existing companies, regardless of the size of the company, the sector in which the company operates, or the nature and type of innovation developed. Their research found that regardless of the innovation activity, a number of common innovation leadership challenges are evident in all innovation activities linked to existing business organisations:

- Their study confirmed that tension between innovation activities and the ongoing business operations of the company is a common fundamental challenge for all businesses involved in innovation. The research recommended that innovation leaders must mediate the relationship between ongoing operations and innovation initiatives by trying to maintain a positive beneficial relationship (Govindarajan and Trimble 2010). The tensions of this innovation paradox are discussed in detail in subsection 2.2.1.
- The ability to conduct and learn from experiments is essential for the design team to move an idea forward towards a tangible outcome. Similar to academic research, this process must pose and test hypotheses in a rigorous scientific manner, only adjusting the hypothesis in response to evidence through experimentation (Govindarajan and Trimble 2010). The experimental process is discussed in detail in this subsection (2.5.3).
- Different organisational structures are required for innovation activities to succeed. Established organisational structures for ongoing operations are unsuitable for innovation activities, as they are focused on efficiency and reliability. The research recommended an organisational structure that nurtures exploration, enabling the innovation team to explore new ideas, report to senior management and proceed with the development of promising new ideas (Govindarajan and Trimble 2010). Organisational structures for innovation are discussed in detail in subsection 2.2.1 along with the innovation paradox. The literature in subsection 2.2.1 supports Govindarajan and Trimble's (2010) view that a different organisational structure is required for innovation. In the discussion of ambidextrous organisational structure, the literature reviewed in subsection 2.2.1 presents explorative organisational structures for innovation initiatives.
- Linked to the unique organisational structures required for innovation is the need for a different planning approach to innovation activities. Planning approaches used for ongoing operations are not suitable for innovation, because they rely on quantitative data analysis of previous sale cycles, which are non-existent for innovation. Innovation is speculative and forward looking in nature. The research recommended a planning strategy informed by the need to achieve new knowledge and organisational learning (Govindarajan and Trimble 2010). Planning for innovation is discussed in subsection 2.5.4.
- Innovation teams need to be cross-disciplinary, ideally composed of a mix of people external and internal to the organisation, involving a balance of organisational know-how (internal) and fresh insights unhindered by organisational culture and working

(external). The research recommended a distinct innovation team structure comprised of a blend of shared staff with responsibilities in ongoing operations and innovation initiatives, and dedicated staff working only on innovation initiatives, comprising internal and external appointments, as shown in Figure 22 (Govindarajan and Trimble 2010). The innovation team composition is discussed in subsection 2.5.5.

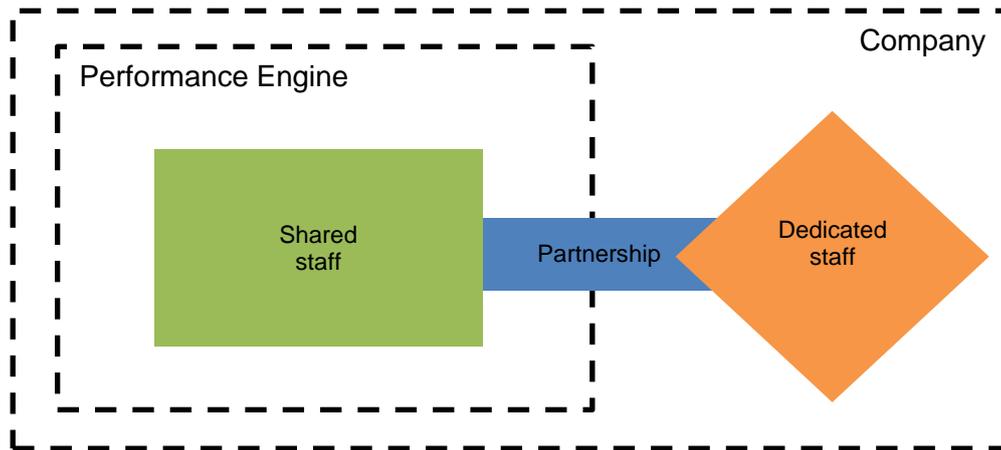


Figure 22: Team structure for innovation projects (Govindarajan and Trimble 2010: 28)

The purpose of creating an organisational structure for innovation, planning innovation activities, building an innovation team, and managing the relationship between innovation projects and the company is essential in order to address the need to conduct experiments to validate and move the innovation process forward. Govindarajan and Trimble (2010) present four essential attributes of innovation experiments, namely:

- Developing and recording a well-defined assumption or hypothesis
- Developing a method for conducting the experiment
- Conducting measurement and analysis of the experiment
- Producing a record of the learning that resulted from the experiment.

In essence, the four attributes describe the process required to construct new knowledge and for organisational learning to occur. It is clear that this experimental process for innovation is similar to the process of academic research. It is also possible that the process of experimentation for innovation might use techniques borrowed from academic research. Innovation experiments and academic research, however, differ in one important way, namely that innovation experiments take place in a business context with an ever-present economic imperative. The economic imperative drives the efficient use of resources to achieve results in a rapid cost-effective manner. Lengthy literature reviews,

well-written articles, dissertations, theses, defences of the methodological approach and an extensive reference list are unlikely to feature significantly in business innovation experiments. Innovation experiments focus on application rather than on explaining the underlying theory.

Testing well-defined assumptions with experimental methods, measuring, analysis and recording the results for the purpose of innovation in a business context have attracted significant attention from the academic research community. Studies of new product development, innovation, design, design management and design thinking all contribute to investigating methods employed by companies to conduct innovation experiments. The methods employed helped describe how assumptions are developed, what measurements are used, and how analysis and reporting are done. This section contains a detailed discussion of some of the existing methods used for innovation experiments. Firstly, it is important to divide experimental processes into two groups, namely quantitative and qualitative experiments. Both quantitative and qualitative methods have value for innovation experiments, and it is important to understand the strengths and weaknesses of both groups of experimental procedure in order to determine which of the two groups is best suited to achieving the required results. The quantitative group of experimental processes uses numeric values to measure and analyse the results of experiments. This approach is best suited to the measurement and performance of any artefacts created by humans. The qualitative group of experimental processes uses text and language to measure and analyse the results of experiments. This approach is best suited to the measurement and understanding of people.

Innovation – the process of selling new or improved products, services or processes to people in the target market – implies that both quantitative and qualitative experiments should be used. Quantitative experiments measure the performance of the new or improved product, service or process (functional acceptance), while qualitative experiments measure and understand the needs, problems and willingness of people in the target market to purchase the company's innovation (market acceptance). The fields of design (Ravasi and Stigliani 2012), design thinking (Dorst 2011) and design management (Fernández-Mesa et al. 2013) contribute to experimentation by providing numerous design techniques (Aken 2004). The design field provides a range of prototyping techniques for testing assumptions (Marion and Simpson 2009; Gerber and Carroll 2012; Bogers and Horst 2014). Prototypes provide opportunities to use both quantitative and qualitative measurement, analysis and reporting of results (Marion and Simpson 2009; Gerber and Carroll 2012; Bogers and Horst 2014). Computer-aided

design (CAD) allows for rapid digital prototyping and has significantly reduced the cost and time required to move conceptual developments forward (Marion and Simpson 2009; Bonnardel and Zenasni 2010). CAD provides an ever-growing range of analysis that can be conducted on computer-generated solid models and assemblies, presenting measurement results within minutes or hours (Marion and Simpson 2009; Bonnardel and Zenasni 2010).

There are many design techniques that can be used to gain a deeper, more qualitative understanding of people and their interactions and experiences that guide the development of innovation. The techniques of self-reflection (Johnson 2012; Hauser, Dong and Ding 2014) and visualisation (Wikström and Jackson 2012) reflect on interactions and experiences created by innovation scenarios, which include prototypes and visualisations (Hembree 2011; Wikström and Jackson 2012; Hauser et al. 2014). Briefing and reframing (Paton and Dorst 2011), personas (Miaskiewicz and Kozar 2011), design by analogy (Moreno et al. 2014), design to elicit surprise (Rodríguez Ramírez 2014), re-design (Smith, Smith and Shen 2012), innovation contests (Adamczyk, Bullinger and Möslein 2012), aesthetics (Talke, Salomo, Wieringa and Lutz 2009; Candi and Saemundsson 2011; Rodríguez Ramírez 2014) and living labs (Dell'Era and Landoni 2014) are all techniques used to gain a deeper understanding of the human factor and its influence on the adoption of new innovation. Each method informs the experiment of the types of assumptions or hypotheses that may be tested, which forms of measurements and analysis are employed, and how the results can be captured and reported.

Collaborative innovation focuses specifically on techniques in which the innovation team is required to collaborate with one or more entities, often from outside the organisation. Co-evaluation (Wiltschnig, Christensen and Ball 2013), sharing user experiences (Sleeswijk Visser, Van Der Lugt and Stappers 2007), integrating customers (Sandmeier, Morrison and Gassmann 2010; Potra 2017), virtual customer environments (Nambisan and Baron 2009), collaborative prototyping (Bogers and Horst 2014) and selective openness for value creation (Balka, Raasch and Herstatt 2014) are examples of collaborative techniques that make assumptions or pose hypotheses in a collaborative environment. Collaboration differs from techniques that observe participants, such as personas (Miaskiewicz and Kozar 2011), design by analogy (Moreno et al. 2014) and design to elicit surprise (Rodríguez Ramírez 2014). Collaborative innovation implies that two or more groups actively work together to solve problems, and the measurement, analysis and reporting are based on this collaborative premise.

Communication techniques for innovation are found to be important for capturing new knowledge and organisational learning (Sleeswijk Visser et al. 2007; Le Dantec and Do 2009; Wong, Lam and Chan 2009; Dell'Era et al. 2011; Boucher 2014; Zhang, Basadur and Schmidt 2014). Research has found deficiencies in communication, and highlights the critical role of communication language and text in positing experimental hypotheses, developing methods of measurement analysis and reporting on innovation experiments (Sleeswijk Visser et al. 2007; Le Dantec and Do 2009; Wong et al. 2009; Dell'Era et al. 2011; Boucher 2014; Zhang et al. 2014; Thomas, Passaro and Marinangeli 2015).

Business model innovation has attracted the attention of academic research because the business model is a valuable strategic planning tool for assisting in the launch and success of new innovation (Osterwalder et al. 2005; Marion and Simpson 2009). Business model experimentation helps connect the innovation project to the broader business ecosystem (Leavy 2012). Recent developments such as the business model canvas (Osterwalder et al. 2005) have made it possible to experiment with business models, and in so doing have made it possible to include this type of experimentation in the entire experimental process for innovation. Business model experimentation addresses assumptions about how value will be extracted from the new innovation (Osterwalder et al. 2005; Chesbrough 2010; Teece 2010; Zott et al. 2011; Bucherer et al. 2012). The business model canvas, in particular, provides a method for the measurement, analysis and recording of experimental business models (Osterwalder et al. 2005).

A significant challenge to innovation experiments is the ever-present risk of bias (Gillier and Piat 2011; Behrens and Ernst 2014; Liedtka 2014). As with all experimentation, the influence that the researchers have on the factual results of experiments requires monitoring and consideration. Reporting on the risk of bias helps validate experimental findings and point out their limitations. The business innovation environment could possibly learn from validity and reliability strategies employed in academic research. The need to conduct strategic experiments (Govindarajan and Trimble 2005) to move innovation projects forward ensures that resources and effort expended by the company on innovation are productive, resulting in organisational learning and the opportunity to bring innovation to the marketplace (Govindarajan and Trimble 2005; Moultrie, Clarkson and Probert 2007; Biazzo 2009; Desouza et al. 2009; Tuulenmäki and Välikangas 2011; Peterson 2013). Experimentation for the purpose of innovation requires the means to create and record hypotheses; methods to conduct relevant experiments, measurement

and analysis techniques; appropriate forms of recording the findings; and rigour in limiting the effect of bias on the results.

Throughout the literature review on experimentation, significant groupings for experimentation have emerged, namely functional acceptance and market acceptance. Figure 23 below groups the relevant attributes under these two headings. In considering the quantitative and qualitative research paradigms discussed in this subsection, first- and second-order design thinking (subsection 2.2.6), the prevailing two theoretical standpoints for innovation research (subsection 2.1.2), the multidisciplinary definition of innovation (subsection 2.1.1) and the business model generation concept , it is possible to divide experiments for innovation activities into these two groups.

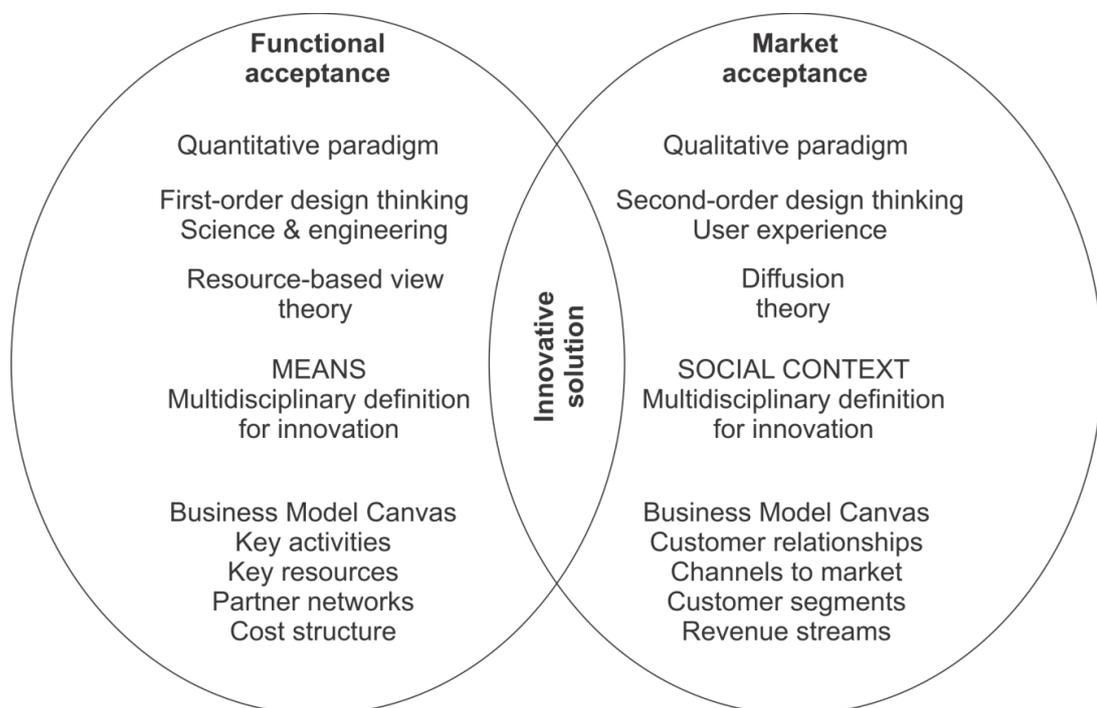


Figure 23: Functional and market acceptance experiments Source: Author

The functional acceptance group of concepts is concerned with how and why the innovation leader, with the assistance of his or her company, is able to turn the innovative idea into a solution that works, in other words, a solution that functions reliably in an expected manner.

The market acceptance group of concepts is concerned with how and why the innovation leader, with the assistance of his or her company, is able to offer the functionally accepted solution to the customer in a manner that is acceptable to the customer. In other words, under what conditions would the consumer be willing to purchase the new solution?

The two prevailing theories related to innovation research, namely the resource-based view and diffusion theory discussed in subsection 2.1.2, are compatible with the groupings of functional acceptance and market acceptance. The resource-based view attempts to understand the basket of material and immaterial resources that a company uses to create and build working innovative solutions and is therefore grouped with the functional acceptance concepts. The diffusion theory attempts to understand how and why new innovations are dispersed through society and is therefore grouped with the market acceptance concepts.

The multidisciplinary definition of innovation has six key attributes, as discussed in subsection 2.1.1. Two attributes in particular, namely *means* and *social context*, are shown to be the focus of the majority of academic studies on innovation, as discussed in subsection 2.1.3. The *means* attribute describes the resources required for innovation to occur, and is therefore grouped with the functional acceptance attributes. The *social context* attribute describes the social entities and environmental factors that influence innovation, and is therefore grouped with the market acceptance attributes.

The business model of Osterwalder et al. (2005) presented in subsection 2.2.4 is divided into nine parts, four of which fit into the functional acceptance grouping and four into the market acceptance grouping. One part, “the value proposition”, resides in the middle and is the ultimate result of the two groupings working together, as shown in Figure 24 below extracted from the review by Chesbrough in (2010: 359).

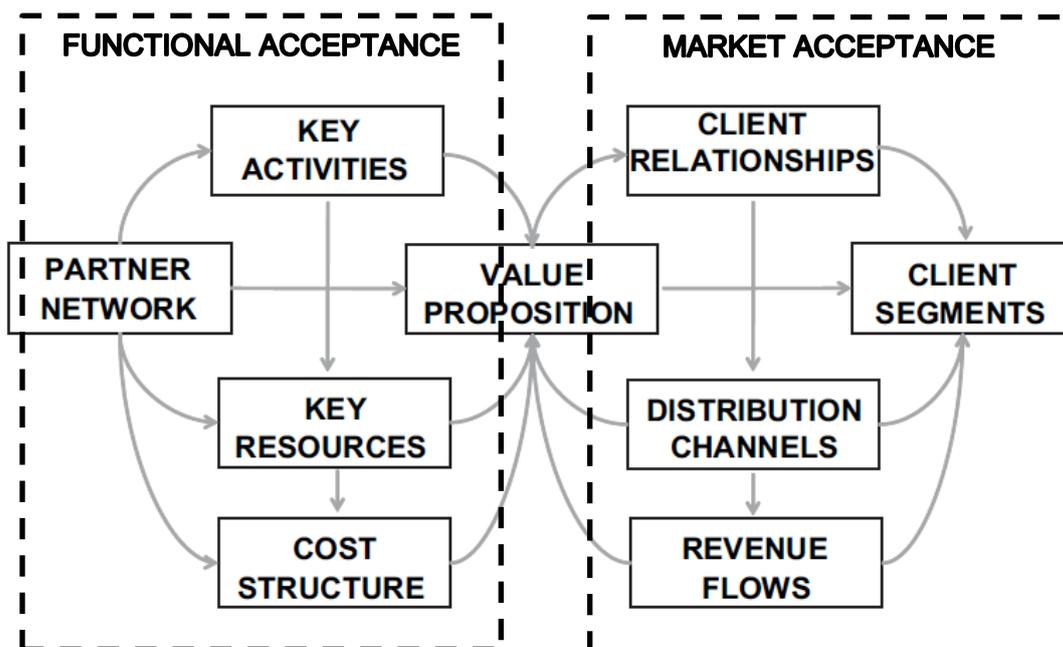


Figure 24: Comparison of functional and market acceptance with business model canvas (Chesbrough 2010)

The grouping of the business model components into the functional acceptance and market acceptance groupings shows strong alignment with the other concepts described. The above concepts help strengthen the pattern described, which implies that the experimental activities of innovation leaders described by these two groupings may be significant to understanding how and why innovation leaders execute innovation initiatives.

2.5.4 Planning for innovation activities

Planning for ongoing operations is predictable. Using previous performance data gathered from the exploitation of current products and services, plans can be developed with a relatively strong degree of certainty (Barrow 2013). Innovation projects, by contrast, are uncertain, without any historical data on which to base predictions (Desouza et al. 2009; Govindarajan and Trimble 2010; Sai Manohar and Pandit 2014). Innovation requires a completely different planning strategy that is based on experimentation and learning (Hoeve and Nieuwenhuis 2006; Desouza et al. 2009; Govindarajan and Trimble 2010; Tuulenmäki and Välikangas 2011). The innovation project team, which is structured to take advantage of organisational learning, uses the experimental learning planning strategy (Govindarajan and Trimble 2010; Tuulenmäki and Välikangas 2011; Menguc, Auh and Yannopoulos 2014; Ruvio et al. 2014).

Planning in order to conduct experiments and interpret results accurately and dispassionately leads to learning, whereby assumptions (hypotheses) are converted into new knowledge (Jun 2008; Govindarajan and Trimble 2010; Topalian 2012). In this mode of planning, plans are only altered by the factual results of experiments. The outcomes of experiments help guide the planning process towards successful solutions to the problems posed by the new idea central to the innovation project. It is challenging to plan, execute and learn from experiments. A level of scientific rigour is called for, as bias in the experimentation analysis and reporting of results is an ever-present threat (Jun 2008; Govindarajan and Trimble 2010; Meesapawong 2013; Bissola, Imperatori and Colonel 2014; Sai Manohar and Pandit 2014; Van Beers and Zand 2014; Weiss et al. 2014).

Planning and measurement strategies for innovation need to adhere to methods used by scientific research as opposed to methods used by ongoing operations in business (Govindarajan and Trimble 2010; Meesapawong 2013; Sai Manohar and Pandit 2014). The innovation workforce focuses its efforts on what management is measuring in its work efforts. Careful measurement choices by leaders and management are therefore required

to ensure that the workforce focuses on the correct outputs. The design management planning function within companies includes firstly understanding and empathising with design, and secondly planning that guides, measures and analyses design.

2.5.5 Innovation team

Contemporary research confirms that the selection of the innovation team members contributes to the organisational structure of innovation activities in the firm (Hutchison-Krupat 2011; Durmusoglu, Calantone and McNally 2013; Bissola et al. 2014). Innovation teams structured through a management process that considers the skills and roles of individuals needed for the innovation project lead to improved results (Hutchison-Krupat 2011; Durmusoglu et al. 2013; Bissola et al. 2014). Innovation team management that coordinates and controls the activities of cross-functional innovation teams in a positive reinforcing manner ensures that the innovation project moves forward and increases its chances of success (Abecassis-Moedas and Mahmoud-Jouini 2008; Dell'Era et al. 2010; Sandmeier et al. 2010; Miller and Moultrie 2013; Bianchi, Frattini, Lejarraga and Minin 2014; Richtnér, Åhlström and Goffin 2014; Enninga and Van der Lugt 2016; Liao and Chun 2016; Madrid, Totterdell, Niven and Barros 2016).

A well-structured innovation team comprising shared staff (Govindarajan and Trimble 2010; Durmusoglu et al. 2013; Bissola et al. 2014), who contribute their company knowledge and experience and partner with dedicated staff consisting of internal and external appointments (Abecassis-Moedas and Mahmoud-Jouini 2008; Dell'Era et al. 2010; Govindarajan and Trimble 2010; Sandmeier et al. 2010; Bianchi et al. 2014; Bissola et al. 2014) provides a platform for developing and commercialising innovative ideas linked to the knowledge and capabilities of the company (Gillier and Piat 2011; Durmusoglu et al. 2013). The partnership between shared staff and dedicated staff is essential. Without this link, innovation is not embedded in the company, and access to the knowledge and experience of the company is cut off (Gemünden et al. 2007; Govindarajan and Trimble 2010; Cantarello et al. 2012; Wei et al. 2014). The shared staff maintain their responsibilities towards the ongoing operations of the company and are included in the innovation project team to share their knowledge, experience and technical know-how gained by working in ongoing operations (Govindarajan and Trimble 2005, 2010; Hutchison-Krupat 2011; Wei et al. 2014). This link is essential to ensuring organisational learning. Dedicated staff can be made up of external appointments and internal company staff (Gemünden et al. 2007; Berends, Reymen, Stultiëns and Peutz 2011; Cantarello et al. 2012; Wu and Haak 2013). The internal dedicated staff are relieved of their duties, titles and positions held in the ongoing operations and given new

full-time roles in the innovation project (Govindarajan and Trimble 2010; Hutchison-Krupat 2011; Jiao and Zhao 2014).

The roles of the innovation team members are established predominantly by the process of innovation, which is often broken into stages (Buijs 2003; Perks, Cooper and Jones 2005; Desouza et al. 2009; Acklin 2010). Having a clearly defined innovation process is advantageous, as it allows for team dialogue and building common understanding of innovation within the organisation (Desouza et al. 2009). Two important roles of innovation team members have attracted significant attention from the research community in the recent past, namely design management and design thinking (Gornick 2008; Fixson 2009; Adams, Daly, Mann and Dall'Alba 2011; Gillier and Piat 2011; Miller and Moultrie 2013). Design management makes a significant contribution to innovation activities and includes defining the roles of innovation team members. Design management is discussed in greater detail in subsection 2.2.6. Design thinking is an emerging line of inquiry that supports and is often linked to design management (Liedtka 2014). Design thinking is discussed in greater detail in subsection 2.2.6. Another factor that influences the roles of innovation team members is their relationship with authority at organisational and tactical levels (Hutchison-Krupat 2011; Koch 2012; Richtnér et al. 2014). This relationship may be described in different ways, including the resource-based view (Hutchison-Krupat 2011; Richtnér et al. 2014) and the nature of the innovation team (Koch 2012), to mention just two. Any social environmental factor related to the innovation team's relationship with authority can be influential. The way in which this relationship is managed by the innovation manager or leader in order to maintain a positive relationship is most important.

The capabilities of the innovation team are spread across and manifest among the shared and dedicated staff. The innovation team as a whole should be capable of accessing internal tacit company knowledge and experience, as well as external knowledge and market conditions. The capabilities of innovation teams have received significant attention from academic research, and contemporary lines of inquiry include:

- Team competencies in solving problems in a collaborative manner with internal and external partners, including customers (Kleinsmann and Valkenburg 2008; Greer and Lei 2012; Wiltschnig et al. 2013; Bogers and Horst 2014; Siebdrat, Hoegl and Ernst 2014).
- The way in which decisions are made within innovation teams (Yang 2010), and which methods are used to evaluate ideas (Hansen 2007; Le Dantec and Do 2009; Wong et al. 2009; Chamakiotis, Dekoninck and Panteli 2013; Bissola et al. 2014).

- The way in which the cognitive styles and cognitive conflicts within innovation teams contribute to innovative performance (Badke-Schaub, Goldschmidt and Meijer 2010; De Visser, Faems, Visscher and De Weerd-Nederhof 2014).
- The ways in which ideas are communicated and recorded, and this information is shared and distributed (Boucher 2014; Zhang et al. 2014).
- The ways in which, and the extent to which, the perceptions of innovation teams affect team performance in positive and negative ways (Markham and Lee 2014; Nikander, Liikkanen and Laakso 2014; Weiss et al. 2014).
- Design management provides methods for measuring and evaluating the creative outputs of innovation teams (Rosensweig 2011; Wiltschnig et al. 2013; Birdi, Leach and Magadley 2014; Fiorina 2014; Vinayak and Kodali 2014).
- Design management contributes to an open and productive innovative relationship with the broader external ecosystem required for innovation success (Osterwalder et al. 2005; Chesbrough 2010; Bucherer et al. 2012; Leavy 2012; Balka et al. 2014; Bogers and Horst 2014).
- The study of virtual teams found that at the individual level, virtual technology encourages creativity without inhibitors. At the team level, geographic separation, strong team members and strong sub-groups tend to be potential inhibitors. At the technology level, it was found that high levels of synchronicity encourage creativity and richness of communication between virtual design team members (Chamakiotis et al. 2013).
- The relationship dynamics between design team members, and between design teams and the organisation are not only dependent on face-to-face communication, but effective project management and project organisation are required (Kleinsmann and Valkenburg 2008).
- “Decision-making” is pervasive and critical in product design and development (Yang 2010: 345); therefore two methods of decision-making within design teams are considered, namely consensus and single-leader decision-making (Yang 2010). Single-leader decision-making was found to be better, as it provides a faster decision-making process and compares well in quality to consensus-style decision-making (Yang 2010).
- Sleeswijk Visser et al. (2007) developed a model to communicate user experiences with the design team. The model has the following three qualities: enhancing empathy, providing inspiration and supporting engagement. The research found that using the communication tool leads to co-creation and co-ownership, resulting in a

higher degree of acceptance and use of user experiences (Sleeswijk Visser et al. 2007).

- The role of cognitive conflict in design teams to support the development of creative ideas confirms that cognitive conflict in such teams supports creativity (Badke-Schaub et al. 2010).
- The study of four types of innovation teams (autonomous, functional, communities of practice and epistemic communities) found that by matching the correct innovation group to the nature of innovation required leads to the production of effective competitive advantage (Koch 2012). The study indicated that not all innovation teams or company authority structures are the same. Therefore, an understanding of the nature of authority in the company and the types of innovation teams available allows an effective match of these elements to be selected.
- Wiltschnig et al. (2013) support the notion that co-evolution is the engine of creativity in collaborative design projects. The study found that problem solution co-evolution does occur in practice (Wiltschnig et al. 2013).

2.5.6 Summary of the literature review

The literature review has sought to understand innovation within a business context and how innovation leaders in existing companies contribute to successful innovation. The multidisciplinary business definition of innovation by Baregheh et al. (2009) presented several common attributes. Two attributes, in particular the *social context* and *means* attributes, were shown to be the focus of most academic studies on innovation in a business setting due to their dynamic and ever-changing nature. The ever-present paradox between ongoing operations and innovation projects requires constant management to ensure that both ongoing operations and innovation projects help move the company forward by balancing exploration and exploitation within the unique dynamics of each company.

The literature review presented the following contributions: the contribution that innovation makes towards the company's strategy to create and maintain competitive advantage; the role that leadership plays in innovation within a business setting; the rise of business model innovation as an integral part of the process used to effectively exploit new innovations, departing from the inflexible practices of the twentieth century to greater openness and flexibility in the twenty-first century; the fundamental requirement for organisational learning to occur in order to innovate and develop new products, processes and services; the design process techniques that explain how unstructured and

competing requirements are blended into solutions to be tested, evaluated and refined into robust solutions ready for commercial exploitation.

The literature review then presented innovation in the South African business context, discussing how the national system of innovation policy has been introduced to stimulate innovation since the democratic elections of 1994. Studies on the impact of the national system of innovation argue that this policy had numerous shortcomings, including the lack of mechanisms to create innovation leadership skills. The two South African innovation surveys concluded in 2004 and 2008 indicated that the bulk of investment in innovation in South African companies has been the acquisition of machinery and information communication technology (ICT) equipment. These acquisitions contributed to improved efficiency and internal process innovation, and only 27% of survey participants successfully introduced innovation to their marketplace. Studies on the drive towards a South African knowledge economy found that South African companies were reluctant to venture into the unknown as required by innovation. These studies recommended strengthening business skills across all levels to encourage a culture of innovation, including creative thinking and problem-solving. The intensification of South African innovation activity has been supported by numerous stakeholders; the national system of innovation policy (NSI), the Industrial Development Corporation (IDC), the Technology Innovation Agency (TIA), the National Advisory Council on Innovation (NACI), the National Development Plan 2030 (NDP), the Organisation for Economic Cooperation and Development (OECD) and the annual South African Innovation Summit. The review of innovation literature in South Africa exposed the limitations of understanding of innovation leadership in this context. The bulk of studies listed in Table 5 show how these studies only make recommendations and calls for further study of innovation leadership in South Africa. Table 6 presents studies in South Africa that have contributed to the establishment of innovation leadership theory in the South African context. The recent work by Urban and Wood (2017) has demonstrated the link between organisational support and the role of individuals in South African companies to identify economic opportunities and drive these opportunities through a process of innovation to commercial success.

The literature reviewed included existing models of innovation leadership. These existing models focused on leadership behaviour and cognitive abilities rather than on the innovation process. Models of the innovation process used by companies were reviewed, and it was found that over time these models changed to match the *social context* and *means* available during the period under study. The innovation process models were applied at the company level and not at the individual level. More recently, Shaw et al.

(2005), Govindarajan and Trimble (2010) and Urban and Wood (2017) have presented innovation process models focused at the individual level.

The innovation process of individuals is the culmination of the literature reviewed. Principles identified to underpin the innovation process of individuals include:

- Synthesis of internal and external learning
- Experimentation
- Organisational structure
- Planning
- Team composition
- Positive relationship between ongoing operations and innovation projects.

This summary of the literature reviewed leads to the conceptual framework developed for this study in section 2.6.

2.6 Conceptual framework

The conceptual framework for this study develops an understanding of the underpinning principles and processes that South African innovation leaders used to successfully bring new innovations to market, and in particular, how innovation leaders created new value while based in the emerging socio-economic context of South Africa. The *means* and *social context* attributes are two interlinked concepts that stem from the multidisciplinary definition of innovation for the business realm, namely: *“Innovation is the multi-stage process whereby organisations transform ideas into new/improved products, services or processes, in order to advance, compete and differentiate themselves successfully in their marketplace”* (Baregheh et al. 2009: 1334). The *means* attribute (technology, ideas, inventions, creativity, market and resource networks) describes how innovation was achieved, while the *social context* attribute (organisation, firms, customers, social systems, employees and developers) describes the people and social systems that played a role in achieving innovation. Without the combination of people and *means*, innovation is not possible. The *social context* attribute is a dynamic ever-changing representation of people and how they are grouped and interact within a *social context* such as groupings defined by nationality, market sector or companies, for example. The contemporary emerging socio-economic context of South Africa is known to have challenges with regard to resource scarcity, gaps in technological know-how and its own unique set of market requirements, as is true for each national grouping around the world (Rooks and Oerlemans 2005; Lorentzen 2009; OECD 2011).

Rothwell (1994) and Chesbrough (2010, 2012) have shown how the *social context* influences the primary *means* of innovation over time. These shifts in primary *means* are a direct result of the contextual challenges experienced during the period under observation, for example the first generation innovation process (1950s to mid-1960s). During this period, advanced economies as in North America and Western Europe experienced rapid growth through industrial expansion (Rothwell 1994). New industries emerged based on a broad range of new technological opportunities, including new composite and synthetic materials, pharmaceuticals, electronic computing and semiconductor development, which were prevalent in the *social context* of these advanced economies. The focus of manufacturing companies was to use research and development (R&D) to create new products using these technologies to service the growing demand (Rothwell 1994).

This first generation innovation process was described as a linear process, “[f]rom scientific discovery, through technological development in firms, to the marketplace” (Rothwell 1994: 8-9). Rothwell (1994: 8) described this *means* of innovation as the “technology push” form of innovation placing emphasis on the notion that increased R&D effect led to greater success for new product output. The “technology push” approach gave very limited attention to the technology development process or the role of consumers in the marketplace in this first generation innovation process (Rothwell 1994: 8).

Rooks and Oerlemans (2005), Lorentzen (2009) and Grobler and Singh (2018) acknowledge that there is limited understanding of how the *social context* of South Africa affects and informs the *means* by which innovation is achieved by South African companies. Issues such as skills shortages manifest as a lack of knowledge, technological innovation, venture capital, skilled labour and restrictive government regulations in the *social context* of South Africa (Rook and Oerlemans 2005). The lack of well-established innovation business skills and problem-solving create reluctance among South African companies to venture into the unknown and experiment with technology and business models (Blankley and Moses 2009; Blankley and Booyens 2010; Booyens 2011). In this South African context, the Department of Science and Technology has applied the national system of innovation (NSI) policy borrowed from First World economies, which does not account for the contextual challenges of South Africa (Lorentzen 2009). The National Advisory Council on Innovation has responded with a new policy framework, currently under development, that intends to address local contextual issues, which include micro-level challenges that South African companies face in order to innovate (National Advisory Council on Innovation 2015). The way in

which innovation takes place in South African companies is not well understood. Lorentzen (2009: 33) refers to this as the “black box” of South Africa’s innovation system. He calls for empirical research at the company level to investigate how innovation takes place. The present research project responds to this challenge by investigating the role of the innovation leader in bringing about organisational learning and launching successful innovation projects at the company level. Research gaps in the South African innovation environment include:

- Insufficient knowledge exists about the primary *means* used in South African companies’ *social context* to innovative (Rooks and Oerlemans 2005; Lorentzen 2009; Grobler and Singh 2018).
- Insufficient knowledge exists about how organisational routines led by individuals drive innovation inside companies (Lorentzen 2009).
- Insufficient knowledge exists about the commercialisation of know-how in businesses, and how this might guide policy (National Advisory Council on Innovation 2015).

Previous studies by Rothwell (1994), McFadzean et al. (2005) and Govindarajan and Trimble (2010) have identified and developed the critical role that innovation leaders play in the achievement of innovation within their companies. Rothwell (1994: 11) implied that successful innovation was the result of “doing most tasks competently and in a balanced and well co-ordinated manner”. He argued that “key individuals of high quality and ability; people with entrepreneurial flair and strong personal commitment to innovation” were at the heart of successful innovation projects (Rothwell 1994: 11). McFadzean et al. (2005) maintained that important factors such as economic circumstances, entrepreneurial teams, social networks, finance, marketing and public agency support, for example, could not create new innovative ventures without a responsible committed person, namely an individual in whose mind the possibilities for innovation come together; in other words the corporate entrepreneur/innovation leader with the prerequisite entrepreneurial attitudes to challenge conventions and encourage innovation by examining a broad range of interrelated factors (McFadzean et al. 2005).

The seminal work of Govindarajan and Trimble (2010: 3-4) investigates how innovation leaders primarily in North American companies have succeeded in the “execution of innovation”. Govindarajan and Trimble (2010) undertook a ten-year longitudinal case study of companies, and the model of the internal learning process that they developed is shown in Figure 25. They found that there were common challenges to the leadership of innovation in existing companies, regardless of the size of the company, the sector in

which the company operates, or the nature and type of innovation developed. The model of the internal learning process in organisations developed by Govindarajan and Trimble (2010) is shown in Figure 25.

Their study confirmed that tension between innovation activities and the ongoing business operations of the company is a common fundamental challenge for all businesses involved in innovation. The research recommended that innovation leaders must mediate the relationship between ongoing operations and innovation initiatives by trying to maintain a positive beneficial relationship (Govindarajan and Trimble 2010).

Different organisational structures were required for innovation activities to succeed. Established organisational structures for ongoing operations were unsuitable for innovation activities, as they are focused on efficiency and reliability. The research recommended an organisational structure that nurtures exploration, enabling the innovation team to explore new ideas, report to senior management and proceed with the development of promising new ideas (Govindarajan and Trimble 2010).

Linked to the unique organisational structures required for innovation was the need for a different planning approach to innovation activities. Planning approaches used for ongoing operations were not suitable for innovation because they relied on quantitative data analysis of previous sale cycles, which were non-existent for innovation. Innovation is speculative and forward looking in nature. The research recommended a planning strategy informed by the need to achieve new knowledge and organisational learning (Govindarajan and Trimble 2010).

Innovation teams needed to be cross-disciplinary, ideally composed of a mix of people external and internal to the organisation, involving a balance of organisational know-how (internal) and fresh insights unhindered by organisational culture and working (external). The research recommended a distinct innovation team structure comprised of a blend of shared staff with responsibilities in ongoing operations and innovation initiatives, and dedicated staff working only on innovation initiatives, comprising internal and external appointments (Govindarajan and Trimble 2010).

The ability to conduct and learn from experiments was essential for the design team to move an idea forward towards a tangible outcome. Similar to academic research, this process must pose and test hypotheses in a rigorous scientific manner, only adjusting the hypothesis in response to the evidence of experimentation (Govindarajan and Trimble 2010).

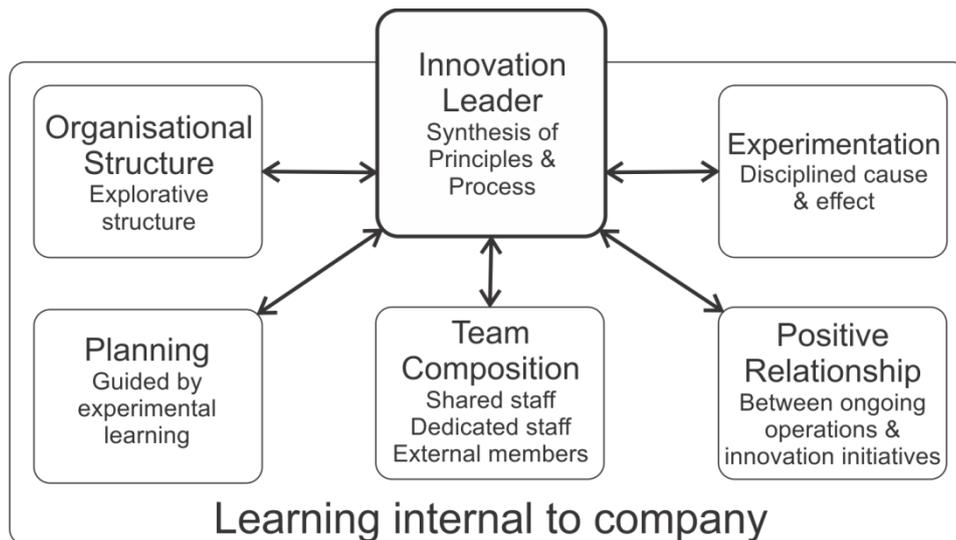


Figure 25: Internal learning process (Govindarajan and Trimble 2010)

The role of the innovation leader within the *social context* and *means* attributes of South African companies is not well understood (Rooks and Oerlemans 2005; Lorentzen 2009; National Advisory Council on Innovation 2015). Through the lens of the innovation leader, this study contributes to filling the gap in understanding of how South African innovation leaders engage with the *means* and *social context*, and the processes through which these engagements helped them to achieve innovation at their companies. This study focuses on the following external and internal concepts:

External concepts

- External resource networks
- Technology
- Market requirements
- How external resource networks, technology and market requirement concepts are integrated by the innovation leader in successful innovation projects.

Internal concepts

- Experimentation
- Organisational structure
- Planning
- Team composition
- Maintaining a positive relationship between ongoing operations and innovation projects.

The conceptual framework places the innovation leader at the centre, as this person is the lens from which the conceptual framework is developed, as shown in Figure 26. In this conceptual framework, the innovation leader plays the central role of synthesising the range of concepts extracted from the literature. The conceptual framework presents the constructs in a non-linear range of interactions, with the innovation leader delineated by a boundary between internal and external learning. This purposefully unsequenced set of interactions helps demonstrate how learning is unstructured, with multiple sources of learning interacting with the innovation leader in an ongoing manner.

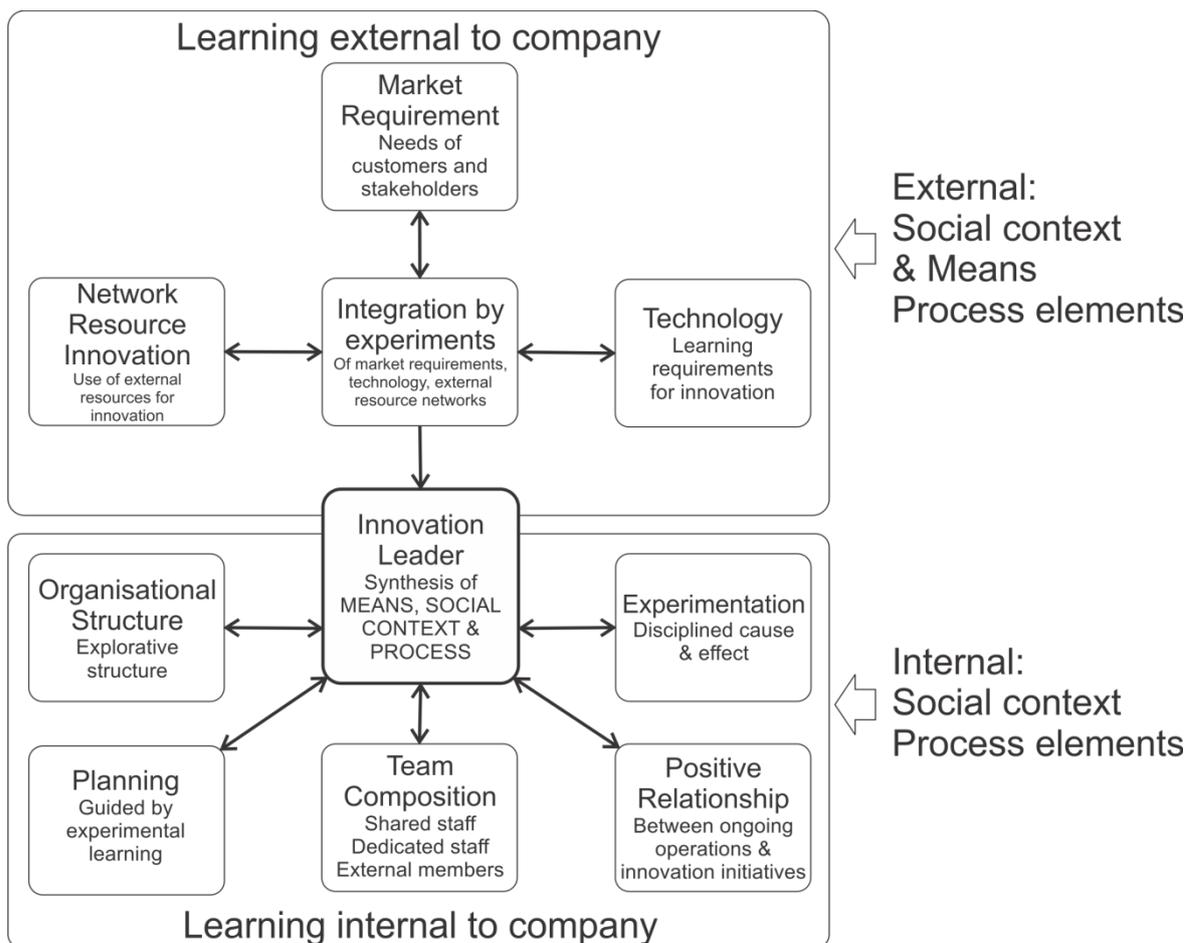


Figure 26: Innovation leader conceptual framework

In summary, the conceptual framework is used to develop the research design and methodology presented in chapter 3.

Chapter 3: Research Design and Methodology

Using the case study method, the purpose of the study was to determine how principles underpin the processes used by successful innovation leaders in South African companies, and in so doing to develop a model that describes the common actions that innovation leaders use to successfully commercialise innovations in South African companies. This chapter describes the research design in section 3.1 and the way in which the case study methodology is applied in section 3.2. The limitations of the study are discussed in section 3.3, and the ethical procedures followed are explained in section 3.4.

3.1 Research design

This study used the constructivist research paradigm to investigate and explain how principles are used by successful South African innovation leaders in their place of work. The ontology of this paradigm provides for multiple subjective realities constructed through human interaction, which in this study are the innovation leaders (Archer 2016). The epistemology that was used to uncover the truth was to understand common actions of innovation leaders across multiple cases using the principles presented in the conceptual framework, and to understand the influences of the *social context* (Archer 2016).

Based on the initial formulation of a research problem captured in the research question, problem and thesis statements, the logic of formulating a research design for this study adhered to Babbie and Mouton's (2007) logic of scientific inquiry for empirical social research. First and foremost the research question was posed as an empirical question which implied that the research question intended to answer a "real-life" problem as opposed to non-empirical questions which focus on theoretical and or abstract constructs (Babbie and Mouton 2007). The research question for this study was explanatory in nature and relied on the collection of primary data from the unit of analysis "Successful Innovation Leaders". This "Primary Data Design" (Babbie and Mouton 2007: 76) gave the researcher some control over the primary data collected which required the researcher to put in place measures to ensure that an acceptable level of objectivity was maintained. These measures are discussed in detail in sub section 3.2.6. Finally the type of data that was required for this research design was text based data transcribed from semi-structured interviews with the unit of analysis "Successful Innovation Leaders".

The principles of research design classification described by Babbie and Mouton (2007) were presented as follows:

- Empirical study (explanatory real-life questions)
- Using primary data (semi-structured interviews with successful innovation leaders)
- Textural data (to be analysed with Computer-aided Qualitative Data Analysis Software tools)

This research design classification was used to determine what research methodologies could have been successfully applied to achieve the evidence required to adequately answer the research question posed at the start of the study. In terms of research methodology this study considered using three distinct methodologies based on the classification of the research design that was developed for this study.

The methodologies considered were:

- Survey
- Participatory action research
- Case study

The survey methodology is a tried and trusted method of qualitative scientific enquiry that could have been used in this study to get primary data from innovation leaders throughout South Africa. The strength of this method is the ability to collect a representative sample of data from innovation leaders allowing the results to be generalised. However, collecting a representative sample implied that the survey would need to be completed independently by participants without the researcher being able to directly interview each participant as the cost and time required for face to face interviews with a representative sample would have been prohibitive.

The participatory action research methodology was considered as it ensured that the researcher would be directly involved as an active participant in a selected company's innovation projects and processes working hand in hand with the company's innovation leader. The advantage of this method would be the great depth of understanding that could be achieved by the data collected. However, gaining this level of access to the inner workings of a company's innovation process was considered to be a significant challenge. Furthermore the duration of innovation projects are difficult to determine with many projects spanning months or even years in some cases. This potentially lengthy time duration implied that the researcher would have to take a lengthy sabbatical from his current employment and responsibilities to effectively pursue the participatory action research methodology.

The case study research methodology was considered as it gave face to face access to innovation leaders at multiple companies. The researcher could conduct face to face semi structured interviews where the innovation leader concerned could recount how they conducted innovation projects that had already been successfully launched into their industry. The strengths of this method were that the data collected originated from projects that were commercially successful which was a key driver of the research. Secondly, as the projects were already completed collecting the data from interviews with the innovation leaders could be achieved in a relatively short time period. The fact that data collection could occur quickly made it easier to collect data from multiple cases to strengthen the value of the research project. Due to the clear advantages of the case study method to collect relevant data posed by the research questions in an easy and timeous manner resulted in this method being chosen over the two other methods considered by this research project.

A multiple case study methodological approach was used to gain insight into and understanding of innovation leaders within their business context. The case study method was chosen as this method is commonly used to gain in-depth understanding and answer “how” type research questions.

3.1.1 Selection of participants

The data collected from this multiple case study were intended to identify innovative leaders working at established companies who had successfully launched innovations into their marketplace. The unit of analysis in this study was the innovation leaders themselves, and how they specifically contributed to successful innovation projects in their company. In order to identify successful innovations and the innovation leaders directly involved in these projects, the following process was used: the researcher created a list of 30 South African companies that had been recognised in awards schemes for innovations that they had successfully introduced to the market. The researcher contacted each company telephonically to establish contact with the innovation leaders at these companies.

The initial target was to attempt to conduct at least five case studies. From the initial list of 30 companies, the recognised innovation leaders at 12 companies expressed their willingness to participate. Each of the 12 potential participants was sent a set of detailed documents explaining the criteria for participation in the case study and the expectations of participants (see Appendix 3 for details of the participant information sheet and participant consent form). The criteria for participation specifically requested that the innovation leader to be interviewed must account for how he or she put into practice the

principles of innovation leadership raised in the research question. Each innovation leader was required to obtain consent from their company to participate and to complete the participant consent form. Of the 12 innovation leaders who initially expressed an interest in participating, eight completed the company and individual consent forms in order to participate. The interview with each of the innovation leaders confirmed that they had led the innovation initiative/s under discussion and that they were responsible for executing the principles in the research question. In summary, eight set of participants and their companies completed the consent documentation. One case study was used as the pilot study leaving seven case studies to make up the data collected for the main study.

In order to gain a deeper understanding of how South African innovation leaders execute the innovation leadership principles, this research made use of the multiple-case study method. The case study method was chosen because it provides a scientifically valid method for observing successful South African innovation leaders from within their business context. The multiple case study allowed the researcher to observe multiple innovation leaders and gather data on how each innovation leader applied the principles to his or her company's successful innovation projects. Collecting data from multiple cases allowed the researcher to identify common and unique practices that explain how innovation leaders organise, plan, select teams, conduct experiments, engage with the external constructs of technology, market requirements and resource networks while maintaining a positive working relationship within their own firm. The intention in collecting and analysing this data was to:

- Confirm or dispute whether the principles identified by the conceptual framework are relevant to the South African innovation leadership context.
- Determine how each of these principles contributes to the innovation leaders' efforts to move innovation projects forward in a successful manner.

Confirming the relevance of these principles and understanding how they contribute to local innovation leadership was intended to culminate in a number of feasible recommendations. The implementation of these recommendations helped address the need for competent local innovation leaders who were capable of instilling innovation as a normal course of thinking and acting in their place of business, thereby having a positive impact on innovation in South African companies. The recommendations from this multiple case study research were encapsulated in an innovation leadership model that

South African innovation leaders could apply within their companies to advocate and execute innovation initiatives.

The case study method was chosen, as this allows for the study of the innovation leadership phenomenon in the real-world context of South African businesses (Yin 2014). The case study method does not require the control of behavioural actions and focuses on observing contemporary phenomena; in this case, innovation leadership as it unfolds in the business context (Yin 2014).

This research project specifically makes use of a holistic multi-case design, which implies that the unit of analysis is applied to more than one case. Holistic multiple case studies use replication logic to determine whether the cases under investigation provide similar repeatable results (Yin 2014). This logic provides the basis for making an analytical generalisation from the multiple case studies (Yin 2014). Analytical generalisation, as described by Yin (2014), differs from statistical generalisation as it does not entail generalisation to the population, but instead refers to the analytical replications that occur within the multiple case studies themselves. Analytical generalisation refers to the repeatable matching patterns that are observed across the cases under study. The analytical generalisation in this study was to uncover the repeatable actions of the innovation leaders that contributed to understanding how the principles and resulting processes were applied in the South African context.

3.2 Methodology

This section discusses five important components of case study research methodology, the potential for analytical generalisation and the criteria used to judge the quality of the research design. The five important components of the case study method as described by Yin (2014) are:

- Case study questions
- Case study theoretical propositions
- Unit of analysis
- Logic linking the data to the propositions
- Criteria for interpreting the findings.

3.2.1 Case study questions

Main research question: How do successful innovation leaders in existing South African companies use the *means* at their disposal to *learn* from within their company's *social context* to execute successful innovation projects?

The case study question is based on principles acknowledged to be influential in the successful execution of innovation activities. The research questions are presented in section 1.3 Research questions

3.2.2 Case study theoretical propositions

Each of the nine questions integrated with the main research question are presented, with theoretical propositions and rival explanations posed for the current study.

Question One: How do the innovation leaders' technology learning engagements with their *social context* contribute to innovation projects?

Theoretical Proposition One: Innovation leaders used the *means* of technology in the local *social context* to help develop innovative solutions.

Rival explanations to Proposition One: Alternatively, the innovation leaders did not use the *means* of technology in the local *social context* to develop innovative solutions.

Question Two: How do the innovation leaders' market requirements learning engagements with their *social context* contribute to innovation projects?

Theoretical Proposition Two: Innovation leaders used the *means* of market requirements in the local *social context* to help develop innovative solutions.

Rival explanations to Proposition Two: Alternatively, the innovation leaders did not use the *means* of market requirements in the local *social context* to develop innovative solutions.

Question Three: How do the innovation leaders' external resource network learning engagements with their *social context* contribute to innovation projects?

Theoretical Proposition Three: Innovation leaders used the *means* of resource network innovation in the local *social context* to help develop innovative solutions.

Rival explanations to Proposition Three: Alternatively, the innovation leaders did not use the *means* of resource network innovation in the local *social context* to develop innovative solutions.

Question Four: How do the innovation leaders' external experiments with technology, market requirements and resource networks from their *social context* integrate with innovation projects?

Theoretical Proposition Four: Innovation leaders used experimentation to integrate technology, market requirements and resource networks learning in the local *social context* to develop innovative solutions.

Rival explanations to Proposition Four: Alternatively, the innovation leaders did not use experimentation to integrate technology, market requirements and resource networks in the local *social context* to develop innovative solutions.

Question Five: How do disciplined internal experiments orchestrated by the innovation leaders contribute to new solutions?

Theoretical Proposition Five: Innovation leaders used internal disciplined cause-and-effect experimentation in the local *social context* to seek the truth about assumptions made with respect to the innovative solutions.

Rival explanations to Proposition Five: Alternatively, innovation leaders did not use internal disciplined experimentation in the local *social context* to determine the truth about assumptions made about the new innovative solution.

Question Six: How do organisational structures used by innovation leaders move innovation activities forward?

Theoretical Proposition Six: The innovation leaders' understanding of problems from the local *social context* are assimilated into the organisational structure to explore innovative solutions.

Rival explanations to Proposition Six: Alternatively, innovation leaders do not use an exploratory organisational structure in the local *social context* to develop innovation initiatives.

Question Seven: How does the innovation leaders' planning, informed by organisational learning, guide the innovation process?

Theoretical Proposition Seven: The planning implemented by innovation leaders for innovation initiatives in the local *social context* includes the pursuit of organisational learning, which stems from the innovation leaders' understanding of solvable problems from the local *social context*.

Rival explanations to Proposition Seven: Alternatively, innovation planning is based on the planning strategies used by the ongoing operations of the organisation.

Question Eight: How do the innovation leaders' selection and management of innovation team members provide a suitable mix of competencies to drive innovation?

Theoretical Proposition Eight: The innovation leaders' composition of an innovation team in the local *social context* is made up of internal staff and external members to drive innovation forward.

Rival explanations to Proposition Eight: Alternatively, the mix of internal staff and external members in the local *social context* used by the innovation leader has no effect on the performance of the innovation initiative.

Question Nine: How do the innovation leaders maintain a positive working relationship between ongoing operations and innovation initiatives?

Theoretical Proposition Nine: The principles underpinning the activities of innovation leaders – technology, market requirements, resource networks, integration of internal and external learning through experimentation, organisational structure, planning and the selection and management of the innovation team in the local *social context* – provide a compelling business case for innovation initiatives, enabling innovation leaders to manage open and constructive relationships between ongoing operations and the innovation initiative.

Rival explanations to Proposition Nine: Alternatively, the innovation leaders did not use these principles – technology, market requirements, resource networks, integration of internal and external experimental learning, organisational structure, planning and the selection and management of the innovation team in the local *social context* – to report to senior management on the status of innovation projects.

3.2.3 Unit of analysis

The unit of analysis is the innovation leader(s) at selected South African companies. This research assumes that the innovation leader is a single individual or a small group of individuals working together. The innovation leader is defined as the individual or group that actively participates in the principles identified in the case study questions and propositions, namely:

- Engaging with the business environment
- Running disciplined experiments for innovation
- Using the organisational structure for innovation activities
- Planning innovation activities

- Composing the members of the innovation team
- Managing the relationship between ongoing operations and innovation activity.

3.2.4 The logic linking data to the propositions

The logic linking the data to the propositions detailed in subsection 3.2.2 above is informed by the various existing data analysis techniques presented by Yin (2014). At this research design stage, the following data analysis techniques described by Yin (2014) have been identified as being best suited to case study investigation and have been chosen for use in this study:

- Pattern matching, which attempts to find patterns in the data of each case that match the research questions and theoretical propositions posed prior to data collection (Yin 2014).
- Cross-case analysis, which is similar to pattern matching except that the patterns are matched across cases and not in a single case. Matching patterns across cases allows the study to provide analytical generalisations, as described by Yin (2014).
- Considering plausible rival explanations for the patterns that emerge from the data is an analytical strategy used to strengthen the trustworthiness and credibility of the reported patterns.
- Logic model analysis, which provides the following benefits:
 - It stipulates and operationalises a complex chain of actions (cause and effect).
 - It matches empirically observed actions to theoretically predicted actions.
 - Interventions produce activities with their own immediate outcome; these immediate outcomes produce intermediate outcomes, which in turn produce final outcomes (opening the black box, explaining how a sequence of interventions produces the final outcome).
 - Rival explanations and rival chains of actions can be investigated.
 - The logic model can be graphically representation to describe the complex chain of actions observed.

This holistic multi-case study used pattern matching, cross-case analysis and logic model data analysis techniques. The data collection and interview questions were informed by these techniques. To develop the semi-structured questionnaire linking the resulting data to the research questions and theoretical propositions posed in subsections 3.2.1 and 3.2.2, this study developed a case study research protocol, as recommended by Yin (2014), which is a stand-alone document that can be used by any researcher to replicate the same case study. This document prepares and instructs the researcher for data

collection in the field and is divided into four sections, namely: overview of the case study, data collection procedure, data collection questions and a guide for the case study report. The case study research protocol uses the research questions and theoretical propositions posed in this chapter to develop the questions posed in the semi-structured questionnaire in order to ensure the link between the data and the propositions. The case study research protocol document can be found in Appendix 2.

Finally, the consistency matrix shown in Table 10 below, provides a one-page summary of the logic that links the data to the proposition posed in subsection 3.2.2. Fitting the information into a single table helps check the alignment between the research questions, theoretical propositions, data sources, type of data and methods of analysis.

Main research question: How do successful innovation leaders in existing South African companies use the <i>means</i> at their disposal to <i>learn</i> from within their company's <i>social context</i> to execute successful innovation projects?		
Source of data: Semi-structured interviews with local innovation leaders based on the case study protocol guidelines	Type of data: Interviews Documents Field notes	Analysis methods: -Pattern matching -Cross-case analysis -Examining plausible rival explanations -The development of a model
Question one: How do the innovation leaders' technology learning engagements with their <i>social context</i> contribute to innovation projects? Research sub-purpose one: To determine how innovation leaders' used technology as a <i>means</i> in their local <i>social context</i> to create successful innovation initiatives, thereby determining the contribution of the technology <i>means</i> to the model for innovation leadership in South African companies. Theoretical proposition one: Innovation leaders used the <i>means</i> of technology in the local <i>social context</i> to help develop innovative solutions. Rival explanations to proposition one: Alternatively, the innovation leaders did not use the <i>means</i> of technology in the local <i>social context</i> to develop innovative solutions.		
Question two: How do the innovation leaders' market requirements learning engagements with their <i>social context</i> contribute to innovation projects? Research sub-purpose two: To determine how innovation leaders' established market requirements as a <i>means</i> in their local <i>social context</i> to create successful innovation initiatives, thereby determining the contribution of the market requirements <i>means</i> to the model for innovation leadership in South African companies. Theoretical proposition two: Innovation leaders used the <i>means</i> of market requirements in the local <i>social context</i> to help develop innovative solutions. Rival explanations to proposition two: Alternatively, the innovation leaders did not use the <i>means</i> of market requirements in the local <i>social context</i> to develop innovative solutions.		
Question three: How do the innovation leaders' external resource network learning engagements with their <i>social context</i> contribute to innovation projects? Research sub-purpose three: To determine how innovation leaders' used their external resource network as a <i>means</i> in their local <i>social context</i> to create successful innovation initiatives, thereby determining the contribution of the external resource network <i>means</i> to the model for innovation leadership in South African companies. Theoretical proposition three: Innovation leaders used the <i>means</i> of resource network innovation in the local <i>social context</i> to help develop innovative solutions. Rival explanations to proposition three: Alternatively, the innovation leaders did not use the <i>means</i> of resource network innovation in the local <i>social context</i> to develop innovative solutions.		
Question four: How do the innovation leaders' external experiments with technology, market requirements and resource networks from their <i>social context</i> integrate with innovation projects? Research sub-purpose four: To determine how innovation leaders' integrated external technology, market requirements and external resource networks <i>means</i> in their local <i>social context</i> through a process of experimentation, thereby developing an understanding of how experimentation contributes to the model for innovation leadership in South African companies. Theoretical proposition four: Innovation leaders used experimentation to integrate technology, market requirements and resource networks learning in the local <i>social context</i> to develop innovative solutions. Rival explanations to proposition four: Alternatively, the innovation leaders did not use experimentation to integrate technology, market requirements and resource networks in the local <i>social context</i> to develop innovative solutions.		

<p>Question five: How do disciplined internal experiments orchestrated by the innovation leaders contribute to new solutions?</p> <p>Research sub-purpose five: To determine whether innovation leaders' used disciplined unbiased cause-and-effect experiments in their <i>social context</i>, thereby confirming or disputing whether internal disciplined cause-and-effect experiments contribute to the model for innovation leadership in South African companies.</p> <p>Theoretical proposition five: Innovation leaders used internal disciplined cause-and-effect experimentation in the local <i>social context</i> to seek the truth about assumptions made with respect to the innovative solutions.</p> <p>Rival explanations to proposition five: Alternatively, innovation leaders did not use internal disciplined experimentation in the local <i>social context</i> to determine the truth about assumptions made about the new innovative solution.</p>
<p>Question six: How do organisational structures used by innovation leaders move innovation activities forward?</p> <p>Research sub-purpose six: To determine whether innovation leaders' used explorative organisational structures allowing them and their assigned personnel and resources to explore new ideas in their <i>social context</i>, thereby confirming or disputing whether ambidextrous organisational structures contribute to the model for innovation leadership in South African companies.</p> <p>Theoretical proposition six: The innovation leaders' understanding of problems from the local <i>social context</i> are assimilated into the organisational structure to explore innovative solutions.</p> <p>Rival explanations to proposition six: Alternatively, innovation leaders do not use an exploratory organisational structure in the local <i>social context</i> to develop innovation initiatives.</p>
<p>Question seven: How does the innovation leaders' planning, informed by organisational learning, guide the innovation process?</p> <p>Research sub-purpose seven: To determine whether organisational learning linked to internal and external engagements of the innovation leader is an appropriate planning strategy for innovation initiatives in their <i>social context</i>, thereby confirming or disputing whether planning using a combination of internal and external learning contributes to the model for innovation leadership in South African companies.</p> <p>Theoretical proposition seven: The planning implemented by innovation leaders for innovation initiatives in the local <i>social context</i> includes the pursuit of organisational learning, which stems from the innovation leaders' understanding of solvable problems from the local <i>social context</i>.</p> <p>Rival explanations to proposition seven: Alternatively, innovation planning is based on the planning strategies used by the ongoing operations of the <i>organisation</i>.</p>
<p>Question eight: How do the innovation leaders' selection and management of innovation team members provide a suitable mix of competencies to drive innovation?</p> <p>Research sub-purpose eight: To determine whether the selection and management of innovation team members used by the innovation leader follow Govindarajan and Trimble's (2010) model of team composition in their <i>social context</i>, thereby confirming or disputing the applicability of their model of team composition to the model for innovation leadership in South African companies.</p> <p>Theoretical proposition eight: The innovation leaders' composition of an innovation team in the local <i>social context</i> is made up of internal staff and external members to drive innovation forward.</p> <p>Rival explanations to proposition eight: Alternatively, the mix of internal staff and external members in the local <i>social context</i> used by the innovation leader has no effect on the performance of the innovation initiative.</p>
<p>Question nine: How do the innovation leaders maintain a positive working relationship between ongoing operations and innovation initiatives?</p> <p>Research sub-purpose nine: To determine whether the positive working relationship between ongoing operations and innovation initiatives is maintained by innovation leaders who practised the principles of the conceptual framework in their <i>social context</i>, thereby confirming or disputing whether the innovation leaders' effective execution of the underpinning principles of the conceptual framework gains support from the ongoing operations of South African companies, and determining the contribution of the positive working relationship to the model for innovation leadership in South African companies.</p> <p>Theoretical proposition nine: The principles underpinning the activities of innovation leaders – technology, market requirements, resource networks, integration of internal and external learning through experimentation, organisational structure, planning and the selection and management of the innovation team in the local <i>social context</i> – provide a compelling business case for innovation initiatives, enabling innovation leaders to manage open and constructive relationships between ongoing operations and the innovation initiative.</p> <p>Rival explanations to proposition nine: Alternatively, the innovation leaders did not use these principles – technology, market requirements, resource networks, integration of internal and external experimental learning, organisational structure, planning and the selection and management of the innovation team in the local <i>social context</i> – to report to senior management on the status of innovation projects.</p>

Table 10: Consistency matrix

3.2.5 Criteria for interpreting case study findings

Unlike the quantitative method of statistical analysis, for example, where well-established criteria for interpreting the data exist, in qualitative research each case study is unique and requires the researcher to define the criteria that will be used to interpret the case study findings (Yin 2014). The general analytical strategy that established the criteria for interpreting the case study finding of the research project were to:

- Create a case-study database using ATLAS.ti
- Rely on the theoretical propositions posed in subsection 3.2.2
- Examine plausible rival explanations posed in subsection 3.2.2
- Conduct cross-case analysis
- Develop a logic model.

Using the principles as an underlying theme, this study conducted in-depth interviews with local innovation leaders, matching patterns to establish the common logic that leads to successful innovation.

3.2.6 Criteria for research quality

Five tests are used to judge the quality of the research design, namely trustworthiness, credibility, dependability and confirmability, conformability and transferability. These tests are carried out in various phases of the research project, namely data collection, data analysis and composition of the research findings. In preparation for these quality assurance tests, the following strategy was developed:

Trustworthiness

A pilot case study was first undertaken to test and refine the planned theoretical propositions, rival explanations, research questions and procedures to be used in the formal case study. The pilot case study provided an opportunity to test the trustworthiness using the tests of credibility, dependability, conformability and transferability. The data from the pilot case study were not used in the formal case study.

In summary, the refinements made as a result of the pilot study included refinements to the research questions, theoretical propositions, rival explanations and semi-structured questionnaire. The refinements made as a result of the pilot study are detailed in the case study research protocol in Appendix 2, where a comparison is made between the original protocol prepared before the pilot study and the refined protocol used for data collection in the seven cases used in this study.

Credibility

The credibility of the study was established by using the following techniques:

- **Prolonged engagement**, which means that multiple data collection activities are planned and executed for each case study. Multiple collection activities and prolonged engagement ensure a richer more in-depth set of data. The seven semi-structured interviews were planned to take place over multiple interviews with the participants. Further data was collected from other text based sources for the innovation projects investigated. The prolonged engagement yielded the transcription of seven case studies, contributing to the database of coded quotations that constituted the source of primary data for this study. The database consists of 114,000 words and over 270 pages collected from the seven cases through multiple semi-structured interviews. An electronic copy of the database is included with the appendices in compact disk (CD) media format. Once the data analysis and interpretation in Chapters 4 and 5 had been undertaken, the conceptual framework was presented to the participants for validation and adjustment before presenting the final model.
- **Referential adequacy**, which means that the triangulation of data was achieved. This is done by collecting several different forms of data that are used to triangulate or corroborate the primary data collection method, which is the series of semi-structured interviews. The additional data sources included documentation, direct observations, other sources such as reviews by external parties, and field notes. Across the seven cases, an additional 34 documents were coded and contributed to the triangulation of the seven case study interview transcription documents. Coded quotations from these 34 documents are included in the database and are identified by coded quotations ranging from P8 to P41. The contribution of the triangulation data documents can also be seen in the data analysis tables for business environment engagement by case in Appendix 4.
- **Peer de-briefing** was used to check the coding, themes and thought processes applied by the researcher in analysing the data. As the analysis progressed, the study used peer de-briefing to ensure thoroughness and the application of sound logic. Peer de-briefing took place with Dr Elizabeth Archer (research methodology expert) working for UNISA in March 2017. Dr Archer checked the coding conventions, the themes and the way in which they were applied to the database. She agreed with the logic used and was satisfied that the process had followed the expected practices for

case study analysis. The report is transcribed from the voice recording of the meeting held at her office and can be viewed in Appendix 2.

- **Negative case analysis** was employed when one or more cases did not fit the patterns identified across all cases of the study. Negative case analysis was used to establish how they differ from the norm. In this research, Case Study Two was identified as a negative case as the innovation developed in this case study was withdrawn from the marketplace several months after its initial launch. Case Study Two was used throughout the data analysis chapters and provided data that demonstrated how the patterns that were not replicated in this case (Case Study Two), but were replicated in the remaining six case studies, contributed to the ultimate failure of the innovative product launched by Case Study Two.

Using the multiple techniques stated above was intended to demonstrate and provide compelling evidence for the credibility of the study.

Dependability and confirmability

Dependability

Dependability required that the study provide its audience with the evidence used for the data analysis. The intention for access to the data was that if the audience or other researchers used the same set of data they could reasonably come to same findings. Hence the following data sets are provided:

- Audit trail created using the ATLAS.ti database
- Raw data stored in the database
- Data reconstruction and synthesis product
- Process notes

The dependability of the case study were ensured by the research database created, which included the following:

- **Audit trail:** The audit trail was established by the research database created on ATLAS.ti and the case study research protocol document. Using the case study protocol and the ATLAS.ti database, it is possible to retrace all the steps taken by the researcher in this project. The content of the database was grouped into logical sections described on the database contents page. The contents page is intended to help an auditor or reader to navigate the database.

- **Raw data:** All raw data are stored in the ATLAS.ti database; only the names of people, companies and innovations were removed and replaced with pseudonyms before the raw data were stored in the database. An electronic copy on CD of the case study database is included with the appendices. The seven case study transcription documents (P1 to P7) that contribute to the case study database are stored securely by the researcher and can be made available on request with the permission of the UNISA Graduate School of Business Leadership's Research Ethics Review Committee.
- **Data reconstruction and synthesis product:** Data reconstruction and synthesis products are explained in detail, including the set of codes developed; the themes created and their rationale; the analytical techniques (examining plausible rival explanations, the development of a logic model and cross-case analysis) and the way in which they are applied to the codes and themes (see Appendix 2 for the detailed set of codes).
- **Process notes:** The process notes describe why and how the researcher followed the chosen process and help an auditor follow and make sense of the logic employed. The process notes articulate the researcher's thinking and are captured in the ATLAS.ti database alongside the data analysis. The detailed and comprehensive account of activities ensures dependability and confirmability (see Appendix 2 for the process notes created by the researcher).

ATLAS.ti is one the Computer-Aided Qualitative Data Analysis Software (CAQDAS) packages available to social science researchers. CAQDAS software packages help to simplify and speed up the analysis of qualitative data. Examples of CAQDAS are NUD.IST, ATLAS.ti, AQUAD and Hyper Research. The CAQDAS software helps code and performs rapid analysis of multiple electronic documents, such as text, sound, video and image files. UNISA had purchased a licence to use ATLAS.ti for their post-graduate students and was therefore the software package used by this study. The ATLAS.ti software provided an HTML format audit trail of how the research was conducted helping other researchers to understand and follow the steps taken by the researcher.

Conformability

Conformability is confirmed in a number of ways:

- By ensuring that the research objectives, questions and theoretical propositions match: Conformability is tested by determining whether the research objectives relate to the research questions, and whether the theoretical propositions match these

concepts. The consistency matrix discussed in subsection 3.2.4 is used to check this conformity.

- By determining how relationships exist between the principles under investigation: Conformability entails explaining how a causal relationship exists between actions and that there are no plausible rivals that have caused or significantly influenced the relationship between these actions. Conformability is determined during the data analysis phase; the tactics of pattern matching, cross-case analysis and addressing rival explanations were used to determine the conformability of this study. The conformability is presented in Chapters 4, 5 and 5.

Transferability

Transferability entails ensuring that another researcher following the case study procedures prepared for this study would achieve similar findings and reach similar conclusions when using the same data collected for this study. Transferability ensures that the researcher's bias does not unduly influence the findings and conclusions. In this study, transferability was ensured by producing a detailed written case study protocol and developing the case study database. The case study database was developed using the ATLAS.ti software program.

3.3 Limitations

The case study method, like all other methods, has inherent limitations. The case study method used in this study is limited in its ability to broadly generalise the findings or for the researcher to have prolonged interaction with the cases (not to be confused with prolonged engagement). Prolonged interactions implied that the cases were observed over the duration of the innovation project, which did not occur. Instead the interviews asked innovation leaders to reflect back on previously successful projects. The scope was limited in investigating a specified number of principles, and the model developed as a result of this study is untested.

The findings of the case study cannot be broadly generalised to the entire population of innovation leaders in South African companies because only seven cases were investigated, which do not constitute a representative sample of the entire population. However, developing an in-depth understanding of innovation leadership at a few South African companies is a beneficial first step, potentially proving the analytical generalisability of the principles under study. If the principles are proved to be replicated in all the cases investigated, these findings provide a reasonable foundation on which future studies can attempt to determine the broader generalisability of these principles.

The intention in using this case study method was for the researcher to have limited interaction with each case, providing a snap shot of what innovation leaders have done to execute new innovative solutions. Ideally, prolonged interaction spanning the entire developmental process, which could last from a few months to several years depending on the company and the complexity of the innovation, would yield a far more detailed understanding of the process. The risk in relation to prolonged interactions with ongoing innovation projects is that of not knowing how long they will take and whether they will actually achieve successful commercialisation. This would make selecting cases more challenging. Investigating successfully completed cases allows for rapid data gathering by asking the innovation leader to reflect on past actions, but this approach diminishes the level of detail that is possible. In order to make progress and complete the study in a reasonable period of time, longitudinal interaction was not included.

The scope of the study was limited to the concepts presented in the conceptual framework identified by previous studies. This limitation prevents the potential discovery of concepts that might be important to the execution of innovation leadership. However, no previous studies of the existing concepts have been conducted in South African companies. Therefore, developing an understanding of how these concepts manifest in South African companies has the potential to make a significant impact.

The model developed from the findings, which might explain to some extent how these principles are applied by innovation leaders, is validated by presenting the conceptual framework to the participants after data analysis and interpretation. Ideally, the applicability of the model needs to be proved. However, this falls outside the scope of this study, as the case study method designed for this study is unlikely to provide a suitable method for testing the model and therefore is best left to a future study using a method specifically designed to effectively test the model and produce valid and reliable results.

3.4 Ethical procedures

The potential harm associated with this multiple case study is the identification of participants, their companies and the innovation projects that they successfully commercialise. In order to protect the identity of the pilot and main study participants, the identity of their companies and the identity of the successful innovation projects they executed, the names have been replaced with pseudonyms. Each participant's name has been changed to 'Respondent' plus the case number, for example, Respondent One at Case Study One. The company's name has been replaced with a number, for example, company name changed to Case Study One. The name of the innovative product or service has been renamed Product A or Service A, for example. In preparing the data for

analysis, all respondents' names, company names and names given to the innovative solutions have been removed and replaced with pseudonyms. Furthermore, any other people, companies, innovative products and services referred to by name in the data have been replaced by pseudonyms. The researcher has compiled a complete list of all pseudonyms used for all cases. The list of pseudonyms is stored securely by the researcher and can be made available on request with permission from the UNISA Graduate School of Business Leadership's Research Ethics Review Committee.

The process of protecting the identities of the pilot and main study participants, their companies and the innovations has followed the ethical clearance procedure required by the UNISA Graduate School of Business Leadership. The procedure required written informed consent from each company and from the individuals participating in the case study. Ethical clearance approval was obtained from the UNISA Graduate School of Business Leadership's Research Ethics Review Committee of the UNISA Graduate School of Business Leadership before the pilot case and main case study data were collected from the participating companies and respondents (see Appendix 3 for all ethical clearance documentation). The potential risk of harm to participants was identified, and all reasonable measures were taken to counteract this risk.

Dissemination of findings in the thesis will be made available to the innovation leaders interviewed at each company with the permission of UNISA Graduate School of Business Leadership. No access to appendices will be given without written consent by UNISA Graduate School of Business Leadership's Research Ethics Review Committee.

In summary, Chapter 3 has described the research design, detailed the methodology, addressed the limitations of the method, and explained how ethical research procedures were adhered to and how ethical approval was obtained to conduct the case studies. In the following chapters, the resulting data and analyses are presented.

Chapter 4: Presentation and analysis of data

The logic of the reporting format used in this study was informed by the work of Yin (2014). In his book “Case Study Research Design and Methods”, he suggests several reporting formats for case studies. This study followed the cross-case analysis reporting format suggested by Yin (2014). The cross-case analysis format was chosen because this study attempted to understand how South African innovation leaders applied the principles of innovation leadership in South African companies. This implied that the study attempted to identify and understand the replications of these principles that occurred across different cases, producing analytical generalisations about these principles. In preparation for the presentation and analysis of the data, the logic linking the data and the theoretical propositions was discussed in detail in Chapter 3 in subsection 3.2.4.

The cross-case analysis reporting format spans Chapters 4 and 5, with each chapter devoted to various aspects of this reporting format. In Chapter 4 prior to the cross-case analysis, each case has been briefly introduced and the research questions are posed and answered. This brief introduction and engagement with the research questions, with an example from the cases, is intended to prepare the reader for the cross-case analysis and summation of observed replications. The following process diagram in Figure 27 provides a visual summary of the logic used in the cross-case analysis reporting format.

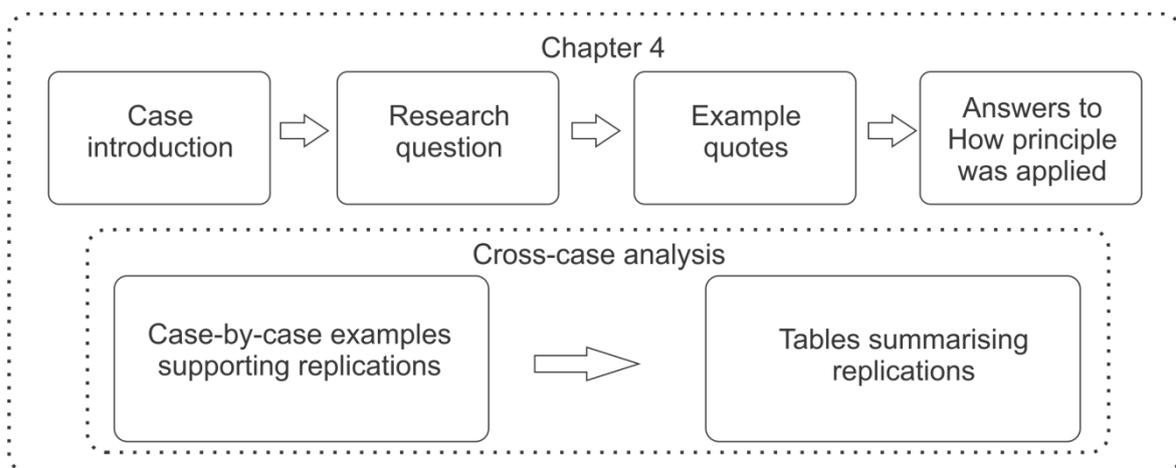


Figure 27: Reporting format logic for Chapter 4

4.0 Brief introduction to the seven case studies

The introduction of the seven case studies provides the reader with a brief context for the innovation and nature of the industry in which these companies compete.

4.0.1 Case Study One introduction

Respondent One works at a company that was established to develop and sell high-efficiency equipment to the mining sector in South Africa. Electrical power shortages in South Africa forced the mining sector to consider ways to reduce power consumption in mining activities. Respondent One used engineering experts to develop solutions that significantly reduced energy consumption while improving equipment performance. The company's innovative solutions were welcomed by industry, securing supply agreements with numerous mining companies. Respondent One continues to grow the business interest by applying the technology to other industrial applications. Recently, an international company purchased a significant share in the company, because Case Study One is considered to be a global leader in the field. The international partner wishes to apply the company's technology to its products that are supplied to various global markets. The innovation leader interviewed (Respondent One) has been with the company since its inception as one of the key innovators establishing the company and continually innovating with the technology as the company has grown. Respondent One continues to lead innovation activity in the new partnership with the international company.

4.0.2 Case Study Two introduction

Respondent Two works at an established company involved in the fast-paced multimedia sector. The company has developed a track record as a leader in locally developed multimedia solutions. Its multimedia solutions have played a significant role in the growth of local multimedia broadcasters. In particular, the innovation leader (Respondent Two) has driven the development of secure billing and subscription management technology amongst numerous other innovations currently operating in the market. The innovation leader chose to discuss a recently developed technology that failed to gain traction with local consumers despite the fact that the new technology had been proved capable of providing unparalleled access to multimedia content. The company continues to develop, manufacture and supply a wide range of electronic and software solutions to numerous industries. As with all innovative initiatives at companies, not all go on to have market success. Case Study Two provides an opportunity to compare a negative case with successful cases to determine how successful and failed innovative initiatives differ.

4.0.3 Case study Three introduction

Case Study Three is a family-owned business. The company was established over 30 years ago to service faulty mining equipment. The owner/innovator, Respondent Three, learned about equipment problems in the mining industry by repairing the faulty equipment. Learning about these problems, Respondent Three was able to design and develop new replacement equipment that was significantly more durable in operation. Due to their close relationship with their customers, they set up a unique repair and maintenance servicing business. The business has continued to grow into many different mining and other industrial applications. This has been possible through continual adaptation and innovation of their equipment to meet each customer's specific needs. The company's ability to customise solutions and provide unique after-sales service ensures that it remains relevant to the needs of its customers.

4.0.4 Case Study Four introduction

Respondent Four works for a long-established South African business supplying sanitary ware products. Many of its established brands are familiar and trusted locally and abroad. Incremental innovation is the order of the day, making sure that the company remains competitive and relevant. The innovation leader has managed a portfolio of innovative projects over the past few years. The company has both local and international shareholders who help extend the company's impact in Africa and to markets outside the African continent. Access to this network helps with production to scale, engaging with emerging trends and technology.

4.0.5 Case Study Five introduction

Respondent Five works at an established financial services provider. Respondent Five has led significant new innovative solutions in the company. Respondent Five has been instrumental in developing financial services linked to online and mobile phone technology. These new innovative service offerings have contributed to significant changes in the way in which financial services are delivered to customers. The organisational structure of the business unit empowers business unit leaders to execute innovation initiatives.

4.0.6 Case Study Six introduction

Respondent Six is the innovation leader and executive board member of a small software services provider company. Respondent Six has extensive experience in the business environment for which the software company supplies solutions. This experience of the business environment was used to start the company based on new and innovative ways of servicing customers in this environment. Now that the company is a going concern,

innovation is used to maintain the relevance of the services provided to the ever-growing list of clients. The success of the company and its unique service approach have allowed the company to expand its markets both locally and internationally.

4.0.7 Case Study Seven introduction

The respondents in Case Study Seven are not a single person but rather a team of four people who lead the innovation initiatives of their company. The company manufactures and sells medical diagnostic equipment to local and international markets. Each of the four innovation leaders focused on different key activities: business development, technology, clinical regulations and medical practitioner/patient requirements. The combined disciplines of these respondents drive the innovative initiatives of the company. This combination of innovative activities has allowed the company to produce new innovative diagnostic solutions that meet the needs of multiple stakeholders in a highly regulated industry. The innovative solutions have been well received locally and internationally, and numerous medical facilities have revised and moulded their diagnostic protocols with respect to the solutions provided by the company.

Each research question and the cross-case analysis are presented in a separate subsection of Chapter 4. The 'HOW' of the research question is answered first with the observed actions undertaken by the innovation leaders. Examples from case studies are used to demonstrate each of the 'HOW' actions observed.

Once the research questions have been presented, the cross-case analysis presents in greater detail how the actions observed are manifested in each case. Each cross-case analysis ends with a table confirming (Yes) or disputing (No) whether the action has been observed. After presenting the evidence from all cases, a cross-case summary table demonstrates the patterns of actions that have occurred across all cases.

4.1 Research Question One

How do the innovation leaders' technology learning engagements with their social context contribute to innovation projects?

Successful innovation leaders demonstrated that they used a synthesis of existing technologies to develop innovative solutions. None of them undertook significant fundamental research to create new knowledge from which new products and services could be developed. In Case Study One, for example, Respondent One used a synthesis of aerodynamics, composite materials, computational fluid dynamics (CFD) and mechanical bearings technologies to develop high-efficiency equipment for the mining industry.

“Initially we went to industry with our background in composite materials we were using composite materials to develop better aerodynamics because it allows us to shape things far more easier than doing metal castings for instance.” P 1: Case study 1.rtf - 1:9

“Once we’ve done our design we use normal numerical analysis work and CFD analysis, computational fluid dynamics to develop a new type of product.” P 1: Case study 1.rtf - 1:4

“Other key features of the products include a patented bearing support system, which reduces the bearing vibration and thereby enhances the products’ bearings protection and extends product life.” P11: Case study 1 on-line media company A.rtf - 11:5

In answering Research Question One, innovation leaders have shown HOW they used technology learning by synthesising existing technologies to create new/improved products and services.

4.2 Research Question Two

How do the innovation leaders’ market requirements learning engagements with their social context contribute to innovation projects?

In five of the seven case studies, successful innovation leaders demonstrated that they used a proactive strategy to learn about market requirements. One case used a reactive strategy to learn about market requirement, and one case failed to learn about their markets requirements altogether. In Case Study Three, for example, Respondent Three went out to industry and identified problems that mining companies experienced with specific imported equipment. He used his understanding of these problems to create new products and services which the local mining companies purchased, because his products and services offered significant improvements in performance and durability, with improved maintenance and procurement services, when compared to the international competitor solutions.

“The mine discovered that the repair costs on PM were very exorbitant, we were put under pressure by the mines who argued that we weren’t repairing the PM correctly therefore we had to prove to them that we are repairing them correctly but the PM was not designed for the purpose they used it for.” P 3: Case study 3.rtf - 3:1

“So, the great thing about that was you’ve been to your customer and you understand the problem and so you needed to come up with a solution.” P 3: Case study 3.rtf - 3:4

“We also put ourselves on the market as not selling a product, but rather selling solutions to problems. Other suppliers in our industry would have 30 or 40 sales representatives on the road virtually going to everybody’s door trying to sell a product. We don’t; we get involved when the guy already has a problem and through our reputation of solving problems, the work actually comes to us. We’ve been very fortunate in building up a good relationship with our customers, and our customers know that if there’s anything that needs special attention or application we’re the first to be contacted, so that helped us a lot on the marketing side.” P 3: **Case Study Three.rtf - 3:24**

In answering Research Question Two, innovation leaders have shown HOW they applied market requirement learning using predominantly a proactive (in five cases) strategy of actively going to their marketplace to learn about problems worth solving for their customers/potential customers. In one case (Case Study Four), a reactive strategy was applied in order to keep up with their competitors. Here the focus was not on technological improvement, but rather stylistic trends were used to reinvigorate sales demand from customers. Case Study Two did not spend time learning about their market’s requirement, and the product was withdrawn from the market after launch due to lack demand.

4.3 Research Question Three

How do the innovation leaders’ external resource network learning engagements with their social context contribute to innovation projects?

Successful innovation leaders demonstrated that they used the “outside-in” method of external resource network learning. None of them used the “inside-out” method of external resource network learning. In Case Study Six, for example, Respondent Six used the internet and smart phones as essential external resources by integrating SMS, e-mail notification and websites into their inventory management service. The “outside-in” approach was applied to these external resources in a manner that allowed their company to control how these resources were applied to their innovative solutions.

“Case Study Six is committed to providing the world’s most accurate inventory management solutions, utilizing the latest software and internet based technologies, for the benefit of those organizations that simply need to know more. Case Study Six offers a single total “end to end” integrated solution encompassing the consulting, hardware, software applications, systems implementation and integration and aftermarket support.” P31: **Case study 6 about us.rtf - 31:3**

“Major features of the technology include:

- Full web-based architecture with user friendly “point and click” interface and contact sensitive drill-down reports.
- Password based access and information security linked to configurable roles-specific functionality. Personalized dashboard views with full complement of online reports with email options.
- Intelligent alerting including: Time-based, location-based and utilization-based alerting with notification via SMS, email and web site.
- Single portal which allows the user to perform a number of key tasks – data entry, reporting, alerting, email, health monitoring.
- Smart Phone apps and dedicated devices with built-in GSM engine for nationwide data transfers.
- On-screen signing with direct throughput to reports for activity validation and proof of delivery.” P33: Case study 6 company profile.rtf - 33:4

In answering Research Question Three, innovation leaders have shown HOW they used external network resource learning by controlling how these resources were applied from within their company. This form of external resource network learning is referred to as “outside-in” use of external resource networks.

4.4 Research Question Four

How do the innovation leaders’ external experiments with technology, market requirements and resource networks from their social context integrate with innovation projects?

The analysis of how innovation leaders used external experimentation presented the following:

- Innovation leaders conduct external experiments that prove functional acceptance.
- Innovation leaders conduct external experiments that prove market acceptance.

External experiments implied that innovation leaders used a range of external guidelines to measure their experiments, as described in more detail in subsection 2.5.3. Guidelines may, for example, originate from industry regulations, scientific and engineering norms, customer satisfaction criteria, cost criteria, technology requirements or any form of reliable external measurement that can be applied to the innovation under development. In Case Study Five, for example, Respondent Five used her businesses *social context* to determine functional criteria based on industry standards and financial regulatory

authority requirements. She used her *social context* engagement with customers to determine which market acceptance criteria were important to the users of the service and continually adjusted the service to help meet their expectations.

“The fundamental premise of Service A is to send service credits from our company account to a phone; it’s as simple as that. The customer then gets the service credits at a customer service point. This basic principle has remained the same throughout the development and implementation. To start with we tested an interest in the product through focus groups. Pricing and things like that were also tested in focus groups. Based on the focus group feedback we proposed how the service would work and we positioned the service in our customer segments. We had to adjust customer segment in terms of our marketing, significantly over time.”

P 5: Case Study Five.rtf - 5:4

“As a result of live testing, we added a tiny little feature that I immediately sent you a PIN without you having to go and get it yourself. This small change led to a thirty per cent increase in customer numbers using Service A.” **P 5: Case Study Five.rtf - 5:14**

“So when you do a development of a product and that includes changes to products, you actually look at everything. You look at system, you look at process, you look at regulatory compliance, you look at risk, you look at financial issues. You have tick boxes and processes that you go through for each one of those. Before you embark on a big change you actually do a business case.” **P 5: Case study 5.rtf - 5:21**

In answering Research Question Four, innovation leaders have shown HOW they used external experimentation to prove both functional and market acceptance of new innovative solutions.

4.5 Research Question Five

How do disciplined internal experiments orchestrated by the innovation leaders contribute to new solutions?

The analysis of how innovation leaders used disciplined experimentation presented the following:

- Innovation leaders conduct disciplined experiments to eliminate the bias of untested assumptions, replacing this with experimental evidence to move the innovation project forward.

Disciplined experiments implied that innovation leaders did not use untested assumptions to guide the development of new or improved products and services. Instead they tested assumptions by using experiments to reveal the truth about the initial assumptions made while conceptualising new ideas. In Case Study Four, for example, Respondent Four demonstrated how she conducted technical tests to meet the regulatory specifications.

“If it is a technical test, then a series of formal tests is done and reported to check compliance with the regulatory authority rules and specifications. Once complete the report goes into the stage gate for approval. If it fails, we either go back to design for refinement or we sometimes cancel the project as it is something we cannot achieve.” P 4: Case Study Four.rtf - 4:16

In answering Research Question Five, innovation leaders have shown HOW they used disciplined experimentation to prove the truth about the initial untested assumptions.

4.6 Research Question Six

How do organisational structures used by innovation leaders move innovation activities forward?

The analysis of how innovation leaders used organisational structures for innovation initiatives presented the following:

- Successful South African innovation leaders demonstrated that they used organisational structure in an exploratory manner to drive innovation initiatives forward.

Successful innovation leaders demonstrated that they used their organisational structure in an exploratory manner in order to gain access to and use the companies' resources and capabilities to learn about specific problems they identified and planned to solve with new innovative solutions. In Case Study Seven, for example, the Respondent Group Seven agreed that the organisational structure of the company is based on the identified needs of their stakeholders. The change of organisational structure towards stakeholder engagement led to the reduction of the sales department in favour of engaging directly with end-users and giving them what they want.

“We restructured the organisation so we have that key focus area for customer service centricity we are calling it stakeholder engagement.” P 7: Case study 7.rtf - 7:28

“Actually it is such a scary thought that our sales department is actually scaled down because we are hoping that this focus on customer and customer

engagement and stakeholder engagement will give us the benefits that our solution will sell itself, that people will come to us rather than us go to them.” P 7: Case study 7.rtf - 7:31

In answering Research Question Six, innovation leaders have shown HOW they used their organisational structure in an exploratory manner to contribute to the successful completion of innovation projects.

4.7 Research Question Seven

How does the innovation leaders' planning, informed by organisational learning, guide the innovation process?

The analysis of how innovation leaders used planning for innovation initiatives presented the following:

- Successful South African innovation leaders demonstrated that they used planning informed by learning to drive the successful development of their innovation initiatives.

Successful innovation leaders demonstrated that they used planning guided by learning to find out about the specific challenges posed by their innovation initiatives in order to plan how their organisation would address these identified challenges. In Case Study Five, for example, Respondent Five's planning for innovation was informed by learning from the needs of the customers blended with the vision and strategy of the company and new advancements in technology that could be exploited to solve customer problems. The initial plan included a business case, which was used to assess the viability of the innovative new ideas. The business case includes regulatory compliance and other internal processes that are required by the organisation.

“It's basically finding other metrics that aren't necessarily financial to build your plans, and that's exactly what we do. So when we plan, we are influenced by our parent company's strategy, it filters down to the segments, to the business units. So you have a plan and your strategy generally does not change radically. The vision of Service A was in line and we also had a very specific Service A strategy.”

P 5: Case study 5.rtf - 5:98

“Strategy gives you your Key Performance Indicators (KPIs). KPIs are dependent on what you deliver or execute. So if your objective is to up your percentage sends by twenty per cent, that's what you are measured against and that's what you report against.” P 5: Case study 5.rtf - 5:102

In answering Research Question Seven, innovation leaders have shown HOW they used planning to learn about the requirements needed to develop and successfully complete innovation projects.

4.8 Research Question Eight

How do the innovation leaders' selection and management of innovation team members provide a suitable mix of competencies to drive innovation?

The analysis of how innovation leaders used team composition for innovation initiatives presented the following:

- Successful South African innovation leaders confirmed that they used a mix of dedicated and shared staff for innovation initiatives. In some cases, dedicated staff included members external to the organisation.

Successful innovation leaders demonstrated that they used a combination of dedicated and shared staff in order to ensure that the innovation initiatives progressed satisfactorily through the division of tasks between enlisted staff members, and that the innovation initiatives remained relevant by linking them to the tacit knowledge, experiences and capabilities of the organisation. In Case Study Four, for example, Respondent Four used a dedicated innovation team made up of three types of team members. Apart from the dedicated team, shared staff members were used during the innovation process. These shared members were brought in at the point where they could contribute to the project. External innovation team members were not used, as previous experience had shown that this approach did not work.

“I mentioned we have got the core team and then shared staff.” **P 4: Case Study Four.rtf - 4:77**

“The core innovation team structure has a designer and a draftsman and most typically a process engineer. Shared staff usually includes a category manager, someone from sales and someone from quality control.” **P 4: Case Study Four.rtf - 4:74**

“As we go through the innovation process we borrow time from different entities in the organisation, which is controlled by our stage gate process.” **P 4: Case Study Four.rtf - 4:78**

In answering Research Question Eight, innovation leaders have shown HOW they used teams that comprised of a mix of dedicated and shared staff members to develop and successfully complete innovation projects.

4.9 Research Question Nine

How do the innovation leaders maintain a positive working relationship between ongoing operations and innovation initiatives?

The analysis of how innovation leaders maintained a positive working relationship between ongoing operations and innovation initiatives presented the following:

- Successful South African innovation leaders demonstrate that they used the principles of the conceptual framework to effectively execute innovation initiatives, thereby maintaining a positive outlook towards innovation.

Successful innovation leaders demonstrated that they maintained a positive relationship between ongoing operations and innovation initiatives by effectively executing the principles in order to convince the organisation's leadership and operational departments that investing time and money in innovation initiatives produced results that led to new value extraction opportunities for the organisation. In Case Study One, for example, Respondent One's actions demonstrated the effective execution of the principles: technology, market requirements, external resource networks, organisational structure, planning, team composition and experimentation. Respondent One created compelling new innovative solutions that gained the support of senior management and ongoing operations.

"In general, from an engineering perspective, I think that these items you mentioned right at the start, are part of how and what we do to develop our products, it's the organisational structure impacting on the innovation side, right, and they coexist in my mind very much." P 1: Case Study One.rtf - 1:171

"My title is operational director, so I'm the operational guy but at the same time I drive a lot of the innovation work in the projects we tackle here, so in a sense, the conflict is internal to me." P 1: Case Study One.rtf - 1:104

In answering Research Question Nine, innovation leaders have shown HOW they used the principles of the conceptual framework to ensure that they maintain a positive working relationship between ongoing operations and the innovation initiative in order to develop and successfully complete innovation projects.

4.10 Cross-case analysis of Research Question One

Across the cases, innovation leaders demonstrated how they used a synthesis of technologies to develop new or improved products and services. Examples from the case studies were used to demonstrate these actions while answering Research Question

One. To avoid repetition of examples in the cross-case analysis repeated excerpts from the data are referenced back to where they appear in the research question.

4.10.1 Case Study One

Case Study One demonstrates the innovation leader's synthesis of existing technologies in the following ways:

Respondent One used a synthesis of aerodynamics, composite materials, computational fluid dynamics (CFD) and mechanical bearings technologies to develop high efficiency equipment for the mining industry. To avoid repetition, the evidence is reported in section 4.1, Research Question One (P 1: Case study 1.rtf - 1:9 & 1:4, P11: Case study 1 on-line media company A.rtf - 11:5)

4.10.2 Case Study Two

Case Study Two demonstrates the innovation leader's synthesis of existing technologies in the following ways:

Respondent Two used a synthesis of electronic technologies integrating electronic hardware and software to develop a unique multimedia device.

"The innovation relied on the chipsets available. The Silicon Manufacture makes the chipset and we build our peripherals such as HD and 4K around the chipset. This locks you into a certain chipset manufacture." P 2: Case study 2.rtf - 2:2

"We got funding to go and spend three months learning about electronic supplier C technology to use as a module into the product development." P 2: Case study 2.rtf - 2:21

"You are locked onto that hardware now you can only innovate around software, so there is software and hardware component to our innovative processes." P 2: Case study 2.rtf - 2:3

4.10.3 Case Study Three

Case Study Three demonstrates the innovation leader's synthesis of existing technologies in the following ways:

Respondent Three used a synthesis of existing mining equipment technology and combined it with new wear and chemically resistant materials that were specifically suited to the particular minerals being mined.

"In particular the material and construction plays a very critical role and if you are not using the correct material for the application you will have a failure immediately." P 3: Case study 3.rtf - 3:10

“The first challenge was how to solve the problem of wear as a result of the solids and the only way we could solve that was by selecting a material that could handle wear. Then we got into the process side and the challenge was to deal with acidic liquids, so it was a totally new material again. The composition of the material in our products has always been challenging as every single application in the mines are different, so you have to really understand the chemical composition of the mined mineral concerned.” P 3: Case study 3.rtf - 3:12

“Going from the gold mines into the coalmines was like two different worlds and slowly we got involved in virtually every single mining type in South Africa and based on what we picked up we managed then to put a database together where we could comfortably select a material for an application because we had already gone through the pains of the research, which materials work, which don't work.” P 3: Case study 3.rtf - 3:14

4.10.4 Case Study Four

Case Study Four demonstrates the innovation leader's synthesis of existing technologies in the following ways:

Respondent Four used a synthesis of existing manufacturing and three-dimensional printing rapid prototyping technologies to develop new sanitary ware products.

“What we would usually do is first a design concept phase from which we grew 3D samples. The printed 3D samples of those conceptual products we either painted or chromed and then put on little display plinths. They then went out to a couple of key people in the market such as architects, specifiers, quantity surveyors in some instances merchants. This was done to test their feeling on the product. Do you like it, do you not like it, what selling point do you think this would reach? If you had to stock how many would you stock? Who would you sell it to, where do you see this product? That usually happens with a new design.” P 4: Case study 4.rtf - 4:2

“From a business perspective, innovation initiatives tie up a huge amount of resources not just in terms of working capital but also space and operations capacity. Because innovation initiative ties up resources we have been forced to change how we innovate and develop new products into a more modular system so that we share components, we share platforms and we share functionality. From the business planning point of view, this approach eliminated a whole lot of working capital and uses less space in the assembly plant. Fitting in with the

shared modular approach ensures assembled methods and time are optimised.” P
4: **Case Study Four.rtf - 4:95**

4.10.5 Case Study Five

Case Study Five demonstrates the innovation leader’s synthesis of existing technologies in the following ways:

Respondent Five used a synthesis of existing cellular phone technology and information technology to create a new financial service offering for their clients.

“Operational highlights Cell-phone registered customer base reached two million in May 2010. Service A (only a cell-phone number required) was launched in November 2009 and transactions through this channel have exceeded R100 million.” P28: **Case study 5 operational results.rtf - 28:3**

“How it worked say for example Service A, the implementation is always shared across Business Units (BU). To roll out Service A, we needed BU 1, BU 2, BU 3, BU 4 and BU 5. These are all separate teams’ business units in their own right. The development of the information technology and the implementation aspect is shared and then your core that is inside your business unit and they are dedicated.” P 5: **Case Study Five.rtf - 5:89**

4.10.6 Case Study Six

Case Study Six demonstrates the innovation leader’s synthesis of existing technologies in the following ways:

Respondent Six used a synthesis of existing programming languages and hardware interfaces to create a new generic software platform that can be customised to manage any kind of inventory item across diverse industries.

“We as a company have created a piece of software that can service A pretty much any inventory item that you can think of. The benefits of this software are we do not have to keep redeveloping solutions for different kinds of inventory items. It does not matter what industry or inventory item there is a certain generic function that is always required when using service A on something of value.” P 6: **Case study 6.rtf - 6:1**

“At the heart of Case study 6’s offering is its award winning proprietary in-house developed generic inventory service engine. The technology is based on a customizable generic business rules with easily configured to industry specific

wrappers. This allows the technology to seamlessly address a wide range of industries.” P33: Case study 6 company profile.rtf - 33:1

4.10.7 Case Study Seven

Case Study Seven demonstrates the innovation leader’s synthesis of existing technologies in the following ways:

The team of Respondents in Case Study Seven used a synthesis of existing scanning technology and their understanding of the medical diagnostic environment to develop a rapid low dose scanning system for medical applications.

“They developed a security scanning system and showed it to doctors from Hospital A suggesting that there might be a medical application for this technology. What they did was to build a working mock-up of the security system and installed that at Hospital A where the doctors were actually able to experiment with this machine to determine the potential for medical applications. The potential was confirmed but there was some features missing and quality of the images needed improvement. That is when they decided to start working on a medical model which we built a first prototype that was then also tested at Hospital A.” P 7: Case study 7.rtf - 7:5

“An innovative team of engineers developed a device that was implemented with success in the security industry. When the core group of engineers realized that such technology could be of immense benefit in the world of medicine, particularly for Emergency and Trauma centres, they formed the Case study 7 company, to further develop the technology for medical use and encourage its sale and distribution worldwide. After some experience it was found that the Case study 7 medical device was also ideal for use by forensic pathologists (medical examiners), as it assisted them in getting an accurate full body assessment quickly.” P35: Case study 7 company webpage.rtf - 35:1

4.10.8 Summary of Technology cross-case analysis

The cross-case analysis of technology used by innovation leaders observed replication across the cases, as shown in Table 11 below. The analysis found that all innovation leaders use a synthesis of existing technologies to develop innovative products and services.

Cross-case summary for the synthesis of technology used by innovation leaders	Case One	Case Two	Case Three	Case Four	Case Five	Case Six	Case Seven
Technology synthesis used for innovation	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 11: Cross-case analysis of technology *means* of innovation

4.11 Cross-case analysis of Research Question Two

Across the cases, innovation leaders demonstrated how they used a combination of proactive and reactive market requirement learning to develop new or improved products and services. Examples from the case studies were used to demonstrate these actions while answering Research Question Two. To avoid repetition of examples in the cross-case analysis, repeated excerpts from the data are referenced back to where they appear in the research question.

4.11.1 Case Study One

Case Study One demonstrates the innovation leaders proactive market requirement engagements in the following ways:

Respondent One demonstrated that he made use of the energy-saving drive initiated by Eskom to develop a new energy-efficient product solution that could be used in mining operations.

“The route we took was the energy savings route to attack the market because our designs were not price competitive, we were quite a bit more expensive than your standard product, so we were basically the Rolls Royce of products and it was difficult to sell it to the market.” P 1: Case study 1.rtf - 1:17

“These projects were funded through Eskom.” P 1: Case study 1.rtf - 1:20

“We got wind of the Demand Side Management (DSM) projects managed by Eskom their DSM subsidiary company approached us to basically sell the product through a DSM project.” P 1: Case study 1.rtf - 1:22

4.11.2 Case Study Two

Case Study Two demonstrates that the innovation leader had no market requirement engagements in the following ways:

Respondent Two led the technical development of the multimedia device without any direct input from customers with respect to their requirements. The management instead

relied on the company's dormant intellectual property and used external consultants to conceptualise a solution based on market trends.

"The parent company discovered we had this Intellectual Property laying around and they said surely we can do something with this Intellectual Property and so they put together a plan and mapped out how they believed this Intellectual Property could be exploited." P 2: Case study 2.rtf - 2:15

"I would love to say it all just started here with a little idea. If we had the faith of our shareholders that we could have done it, it might have had a different ending. They were not prepared to back the technology based on the ideas that bubbled out of these offices. They wanted to use consultants, and in the end they spent millions." P 2: Case Study Two.rtf - 2:18

"What we discovered is that we are a technology house trying to do something that we are not good at, which is multimedia content." P 2: Case Study Two.rtf - 2:67

"While the new multimedia product launched in 2014, Case Study Two failed to tell consumers, multimedia critics, the press and potential subscribers about the content ever again. Parent Company B mistakenly thought South African consumers would buy a device, forgetting that consumers now buy internet-linked devices not for the actual device but for the content it has access to. The publicity for the New Multimedia Product was basically non-existent and where there was anything, it focused only on the actual device, not telling the consumer about the programming. Big marketing billboards only touted the mysterious device, while a multimedia advert focused on the new multimedia product's technical features." P 18: Case Study Two shuts down new product.rtf - 18:2

4.11.3 Case Study Three

Case Study Three demonstrates the innovation leader's proactive market requirement engagements in the following ways:

Respondent Three engaged with his customers to learn about the problems they were experiencing with existing imported equipment. In learning from his clients, Respondent Three was able to develop new product solutions that outperformed the imported competitors. To avoid repetition, the evidence is reported in section 4.2, Research Question Two (P 3: Case study 3.rtf – 3:1, 3:4 & 3:24)

4.11.4 Case Study Four

Case Study Four demonstrates the innovation leader's reactive market requirement engagements in the following ways:

Respondent Four engaged with her marketplace by responding to key informants and tracking their competitors.

“We rely heavily on the market and what is going on outside. If we have developed a new product that is intended to replace an existing product we get our specification representatives to present the new product to key customers like hotels and lodges for feedback. In scenarios where we have lost 80% of products sales to competing product lines, this automatically becomes evidence that we need to react with new product offerings. We also benchmark ourselves against new products competitors launch that we need to follow. So, we rely heavily on market information and competitor behaviour.” P 4: Case Study Four.rtf - 4:60

4.11.5 Case Study Five

Case Study Five demonstrates the innovation leader’s proactive market requirement engagements in the following ways:

Respondent Five engaged with her marketplace by analysing the complaints they received from customers through their call centre. Using the company’s vision of “improving customer service” and the analysis of customer complaints, Respondent Five developed a mobile telephone-based service to provide a new service that overcame some of the frustrating limitations of physical branch-based financial services.

“The innovative Service A builds on top of the company’s value proposition. We believe our value proposition to customers is like a helping hand in our service aspect to their lives. When we innovate, it’s always building on top of that value proposition.” P 5: Case Study Five.rtf - 5:34

“We get a lot of customer feedback through the call centres and operations areas because they deal with the clients who moan. That’s where some of our big innovations come from. We actually take the calls and break them down to analyse what the biggest complaints are then we plan changes based on this feedback.” P 5: Case Study Five.rtf - 5:101

4.11.6 Case Study Six

Case Study Six demonstrates the innovation leader’s proactive market requirement engagements in the following ways:

Respondent Six engaged with his marketplace and discovered that no purpose-built software was available to manage inventory items with standard hardware devices.

Respondent Six used this opportunity to develop a generic software solution, as the industry standard software was found to have significant limitations.

“What we discovered after some investigation was there was nothing out there that already existed to solve our problem. We ended up re-writing the function of the software to overcome the shortfalls in the software Supplier A had originally provided for us so that we could enable the ideal mechanism for transferring data in our range of applications.” P 6: Case Study Six.rtf - 6:2

“Our competitors provide their inventory management service in almost identical ways. They use the well-established methods to provide technical solutions without questioning their methods to find a better more efficient solution. So our company’s value proposition is that we have this innovative idea that allows customers greater efficiency and flexibility to manage inventory items.” P 6: Case study 6.rtf - 6:29

4.11.7 Case Study Seven

Case Study Seven demonstrates the innovation leaders’ proactive market requirement engagements in the following ways:

The Respondents in Case Study Seven engaged with their marketplace to gain an in-depth understanding of multiple stakeholder requirements. Doctors, clinicians, patients, hospital protocols and medical regulations were all important stakeholders with differing needs to be integrated into their product offering.

“We needed to find out from the market first. Through user interactions and customer feedback on the existing features we produced a request for features document based on user requirements. From that we developed the medical machine and started testing user acceptance.” P 7: Case study 7.rtf - 7:3

“What we try to do is immerse ourselves in our customer’s life, to actually learn from their experiences on a daily basis and knowing exactly what they go through and what challenges they are facing. We use web-based platforms to get customer feedback to help plan and gain new knowledge about where to go with innovation.” P 7: Case Study Seven.rtf - 7:80

4.11.8 Summary of Market Requirements cross-case analysis

The cross-case analysis of market requirements used by innovation leaders observed replication across the cases, as shown in Table 12 below. The analysis found that five innovation leaders used a proactive method to learn about market requirements. One

innovation leader used a reactive method, while one did not learn about market requirements.

Cross-case summary of market requirements used by innovation leaders	Case One	Case Two	Case Three	Case Four	Case Five	Case Six	Case Seven
Market requirements using proactive learning to differentiate	Yes	No	Yes	No	Yes	Yes	Yes
Market requirements using reactive learning to compete	No	No	No	Yes	No	No	No

Table 12: Cross-case analysis of market requirements *means* of innovation

4.12 Cross-case analysis of Research Question Three

Across the cases, innovation leaders demonstrated how they used the “outside-in” method of learning from external network resources. In contrast, none of the cases demonstrated an “inside-out” method of learning and engaging with external resource networks. Examples from the case studies were used to demonstrate these actions while answering Research Question Three. To avoid repetition of examples in the cross-case analysis, repeated excerpts from the data are referenced back to where they appear in the research question.

4.12.1 Case Study One

Case Study One demonstrates the innovation leader’s “outside-in” use of external resource networks in the following ways:

Respondent One demonstrated that he made use of external resource networks to capture high-speed images of particles colliding with their composite parts, tensile testing of materials and networking with the “VS” industry body to help develop and promote their products.

“From the coal industry we learned a lot about abrasive particles and their impact on composite products. We used high speed camera footage technology provided by the local South African experts to analyse particle impact on composite materials.” P 1: Case study 1.rtf - 1:12

“We also recently purchased a tensile testing machine we picked up for a song, we were outsourcing most of that work and what it provides us with is a knowledge database of materials, which is critical for us to do our design work.” P 1: Case study 1.rtf - 1:177

“At the “VS” industry body we’re members, we get involved at that level, we present papers, we’ve done presentations in Australia, it’s all things we do

differently to the other product suppliers in this country. P 1: Case study 1.rtf - 1:61

“So, we’re involved at the level where all the “VS” people are, that’s how we also advertise our products and so I think in general our value add from miners’ perspective is enormous.” P 1: Case study 1.rtf - 1:62

4.12.2 Case Study Two

Case Study Two demonstrated the innovation leader’s “outside-in” use of external resource networks in the following ways:

Respondent Two demonstrated that he made use of external resource networks to learn about electronic building blocks that could be incorporated into their multimedia product. Having acquired the technology building blocks from multiple external suppliers, Respondent Two and his innovation teams had to integrate multiple technologies into a single electronic device that met the regulatory requirements for satellite broadcasting.

“We investigate all the technologies that are going to impact on us in the coming three years, some of them we know zero about, we rely totally on our strategic partners which are Silicon vendors.” P 2: Case study 2.rtf - 2:4

“We learn from the top three Silicon vendors and we put what we learnt into our own products.” P 2: Case study 2.rtf - 2:5

“If you are planning to make a wow product that no one has seen before, you go and see how other people are doing things and then come back with that knowledge and add it to the learning curve.” P 2: Case Study Two.rtf - 2:99

“We go and attend major exhibitions, conferences and shows around the world and just see if we are aligned or we are not aligned. Also trends, trends are very important.” P 2: Case Study Two.rtf - 2:100

“In the end you have to get REGULATORY BODY A approval. This is still one of the experimental prototypes but to get REGULATORY BODY A approval we had to make sure that all electronics were harmonised. So it was a major development and you have to have good team leaders, this is definitely not a one man band.” P 2: Case study 2.rtf - 2:37

4.12.3 Case Study Three

Case Study Three demonstrated the innovation leader’s “outside-in” use of external resource networks in the following ways:

Respondent Three demonstrated that he made use of external resource networks to help select the correct materials and standard components from suppliers and design casings

that could be effectively manufactured by foundries. Respondent Three made use of industry bodies to learn about regulatory requirements and new materials.

“At the gold mines they are very deep, the conditions the products work under is totally different to what happens in a coal mine. To solve the problem of wear as a result of the solids we solved that by selecting a material that could handle wear, so that’s how we sorted the gold mines out.” P 3: Case study 3.rtf - 3:12

“I think if we go back also to the period when we were repairing PM we built up a good relationship with most of the suppliers of components such as mechanical seals, cables glands, and as we went along looking at our research and development we’ve built up relationships with certain suppliers of critical components which we can’t manufacture ourselves, I think the most critical part is the castings.” P 3: Case study 3.rtf - 3:42

“We are also involved with a lot of associations, we’re involved with the SSDA, the FP Association, the IF and we also attend a lot of their network groups. They often come up with new ways of doing things from their side, especially the SSDA will do a lot of research and work on materials, so we would be advantaged by getting a lot of that information just as it comes off the press whereas that information would only surface three or four years later if you weren’t involved with the associations.” P 3: Case study 3.rtf - 3:58

4.12.4 Case Study Four

Case Study Four demonstrated the innovation leader’s “outside-in” use of external resource networks in the following ways:

Respondent Four demonstrated that she made use of external resource networks to distribute and sell their products. These external networks also played a significant role in giving feedback on product sales volumes and competitor strategies.

“I think it is important to get that buy-in from your partners that they can see the value in new products and that they support the initiative. If they can make sufficient margin out of the product, then they are happy to stock and sell it. Product lifecycle management becomes very important there as well because what you then do is you replace the dying product which is taking up their shelf space with new products with vibrant sales potential.” P 4: Case Study Four.rtf - 4:34

“New products bring merchants bigger profit margins and high volumes. So, you are in fact providing a good financial motivator.” P 4: Case Study Four.rtf - 4:35

“PARENT COMPANY A distributes approximately 50 000 product lines sourced through more than 2 700 suppliers to over 13 000 customers in the building and

infrastructure sectors. PARENT COMPANY A logistics' arm offers just-in-time break-bulk distribution through its fleet of more than 260 vehicles and trailers on a national basis with over-border deliveries to Botswana, Swaziland, Lesotho and Namibia. Products are distributed through an international, strategically positioned distribution network in sub-Saharan African countries such as South Africa, Angola, Botswana, Democratic Republic of Congo, Lesotho, Mauritius, Mozambique, Namibia, Swaziland, Tanzania, Zambia and Zimbabwe." P24: Case study 4 company overview.rtf - 24:5

4.12.5 Case Study Five

Case Study Five demonstrated the innovation leader's "outside-in" use of external resource networks in the following ways:

Respondent Five demonstrated that she made use of external resource networks to ensure that their mobile transfer solution met local regulations and laws. The mobile phone industry was an essential platform on which the service was built.

"Our innovations must prove their compliance to national regulations and laws that we have to comply with. There are many different forms of compliance depending what business you're in. So we have to work through all of them to ensure we comply with the rules that are relevant to our innovation." P 5: Case study 5.rtf - 5:95

"Our company's service A, a mobile transfer solution launched in 2009, was also named as a finalist in the Product/Service Innovation category of the competition. Service A allows customers to send credit to anyone in South Africa with a valid mobile phone number." P30: Case study 5 world's most innovative FSP.rtf - 30:4

4.12.6 Case Study Six

Case Study Six demonstrated the innovation leader's "outside-in" use of external resource networks in the following ways:

Respondent Six demonstrated that he made use of external resource networks such as the internet and smart phones as essential external resources by integrating SMS, e-mail notification and websites into their inventory management service. To avoid repetition, the evidence is reported in section 4.3, Research Question Three (P33: Case study 6 company profile.rtf - 33:4 and P31: Case study 6 about us.rtf - 31:3)

4.12.7 Case Study Seven

Case Study Seven demonstrated the innovation leader's "outside-in" use of external resource networks in the following ways:

The team of Respondents in Case Study Seven demonstrated that they made use of external resource networks to maintain the safety status, conduct new research and use industrial designers to improve the aesthetics and function of the machine.

“In the medical field is about testing and validation. So verification and validation are two big crunch points. Once you do new developments you have to show that the new changes still comply to the safety requirements through testing. Each country has different requirements so you have to do separate testing and validation based on their requirements before you can introduce the product.” P 7:

Case study 7.rtf - 7:24

“We have a research program collaborating with University A which has been quite active over the past 10 years or more. We facilitate student projects with ideas we would like tested a combination of undergraduate and postgraduate projects.” P 7: **Case study 7.rtf - 7:2**

“The research is published in peer-reviewed journals, thus furthering knowledge and validating the technical claims about the Case study 7 product.” P40: **Case study 7 on-line media 2014.rtf - 40:3**

“We needed to jazz up our machine because it looked very engineering. So we enlisted help from design experts, we used industrial designers to improve the overall look and operation of the machine.” P 7: **Case study 7.rtf - 7:68**

4.12.8 Summary of External Resource Networks cross-case analysis

The cross-case analysis of external resource networks used by innovation leaders observed replication across the cases, as shown in Table 13 below. The analysis found that all innovation leaders applied an “outside-in” method to use and engage with external resource networks.

Cross-case summary of external resource networks used by innovation leaders	Case One	Case Two	Case Three	Case Four	Case Five	Case Six	Case Seven
External resource networks contributed by using the “outside-in” method of engagement	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 13: Cross-case analysis of external resource networks for innovation

4.13 Cross-case analysis of Research Question Four

Across the cases, innovation leaders demonstrated how they used external experiments with technology, market requirements and resource networks to prove functional and market acceptance of new or improved products and services. Examples from the case

studies were used to demonstrate these actions while answering Research Question Four. To avoid repetition of examples in the cross-case analysis, repeated excerpts from the data are referenced back to where they appear in the research question.

4.13.1 Case Study One

Case Study One demonstrates the innovation leader's proof of functional and market acceptance experiments in the following ways:

Respondent One used his business environment engagements to determine the functional performance requirements based on the industry standards demonstrated by the findings of the independent M&V performance report. He engaged with his business environment to learn about the electric energy-saving incentives provided by Eskom to determine market acceptance criteria for their new equipment ideas.

“The performance of the project is not seasonal. The M&V team is confident that the project will be able to sustain this saving in the future as long as the client maintains the system properly.” P13: **Case study 1 performance assessment.rtf - 13:2**

“The DSM project allowed us to do very big projects, we replaced close to a 1 000 products in various mining houses all put together, but that was obviously only after we had developed this product that was very energy efficient and actually delivered on what was promised.” P 1: **Case study 1.rtf - 1:23**

4.13.2 Case Study Two

Case Study Two demonstrates the innovation leader's proof of functional performance requirements, but absence of market acceptance experiments, in the following ways:

Respondent Two used his business environment engagements to determine the criteria for functional performance requirements only, based on the broadcast regulatory standards and other standards relevant to electronic consumer goods. Respondent Two and his company did not engage with the end-consumers to determine what market acceptance criteria were important to them. In retrospect, it emerged that access to multimedia content was the most important need of their customers.

Customer A, for example, is locked into a Java-based operating system which is good, but maybe in the future, it is a browser. So, the first thing we did was test the idea of using a browser-type system. We had no understanding of how to put a browser over the satellite system, so we had to build experiments and learn from the results how to do it. P 2: **Case Study Two.rtf - 2:25**

To avoid bias we have methodologies in place to ensure the development meets

all its functional requirements. P 2: Case Study Two.rtf - 2:39

“Unlike other South African multimedia players who issue regular programming publicity alerts, Parent Company B after launching their new multimedia product never told potential buyers and new or existing subscribers about the actual multimedia content they could get access to and specifically what it was, or the new content as additional programming was acquired and cycled through.” P 18: Case Study Two shuts down new product.rtf - 18:3

4.13.3 Case Study Three

Case Study Three demonstrates the innovation leader’s proof of functional and market acceptance experiments in the following ways:

Respondent Three used his business environment engagements to determine functional criteria based on industry standards. He also used his business environment engagement to determine the market acceptance criteria of his customers, which required durable products that matched sales and maintenance cycles of the mines.

“At the gold mines they are very deep, the conditions the products work under is totally different to what happens in a coal mine. To solve the problem of wear as a result of the solids we solved that by selecting a material that could handle wear, so that’s how we sorted the gold mines out.” P 3: Case study 3.rtf - 3:12

“A big benefit to us was the mines allow you to come pick the product up, take it to your workshop, repair it, take it back again, so when getting involved in repairing our own product we also evaluate the wear rates and if a product would last 24 months we’ll say well, why can’t we get another month or two out of it, what can we do to improve it.” P 3: Case study 3.rtf - 3:22

4.13.4 Case Study Four

Case Study Four demonstrates the innovation leader’s proof of functional and market acceptance experiments in the following ways:

Respondent Four used her business environment engagements to determine criteria for functional acceptance by using the industry standard performance measurements. Respondent Four used her business environment engagement to determine criteria for market acceptance from key market informants such as architects, specifiers, retailers and competitors.

“If it is a technical test, then a series of formal tests is done and reported to check compliance with the regulatory authority rules and specifications. Once complete the report goes into the stage gate for approval. If it fails, we either go back to

design for refinement or we sometimes cancel the project as it is something we cannot achieve.” P 4: Case Study Four.rtf - 4:16

“It is part of the stage gate process obviously if it is a visual design product then we will have a mini questionnaire that goes along with the sample that gets completed. That information comes back and is consolidated into a survey of results that gets presented at a stage gate meeting where all the relevant stakeholders need to sign off on the progress made.” P 4: Case Study Four.rtf - 4:15

4.13.5 Case Study Five

Case Study Five demonstrates the innovation leader’s proof of functional and market acceptance experiments in the following ways:

Respondent Five used her business environment engagements to determine functional criteria based on industry standards and financial regulatory authority requirements. She used her business environment engagement with customers to determine which market acceptance criteria were important to the users of the service and continually adjusted the service to help meet their expectations. To avoid repetition, the evidence is reported in section 4.4, Research Question Four (P 5: Case Study Five.rtf - 5:4, 5:14 & 5:21)

4.13.6 Case Study Six

Case Study Six demonstrates the innovation leader’s proof of functional and market acceptance experiments in the following ways:

Respondent Six used his business environment engagements to determine contemporary functional criteria for software development and testing. Respondent Six continually engaged with his customers to determine what market acceptance criteria would drive them to adopt their inventory management solution.

“Initially, experimentation is superficial at the development stage. Once a working software solution is built we move into a testing phase in-depth experimentation involving the internal environment tests the rest of the solution as a whole. After successful internal testing, we then look to emulate testing to an external environment. In other words what we would generally try to emulate the external environment of a client exactly. We run the new code in that environment to make sure that we hit the objectives.” P 6: Case Study Six.rtf - 6:11

“So what we do on a regular basis is we go to the clients; we sit down with them and in a not too structured session say let us sit down and figure out what it is you now need from us and the kinds of ideas they come up with they actually helped us to evolve our product.” P 6: Case Study Six.rtf - 6:37

“They help us to evolve the solution. That it is a big secondary benefit of going to them and getting them to help us. Because they do feel that we are really a company that have not dropped off this piece of software. We are here to make sure that they become fully and utterly reliant on us. We are upfront with them. We want you so reliant on us that you could not possibly get rid of us. The way in which we do that is to make sure that this solution is everything you could have hoped for and more. So it is a symbiotic relationship.” P 6: Case study 6.rtf - 6:45

4.13.7 Case Study Seven

Case Study Seven demonstrates the innovation leader’s proof of functional and market acceptance experiments in the following ways:

Respondent Team Seven used their business environment engagements to track utilisation, which helped them to determine how medical regulations had been achieved as part of their minimum functional criteria. Respondent Team Seven used their business environment engagement to determine market acceptance criteria by constantly engaging with their stakeholders.

“So, we implement a lot of test projects to see what works. Is the update better with certain configurations or not so we track utilisation to see whether it actually had an impact?” P 7: Case Study Seven.rtf - 7:13

“We try to get the user involved right up front early on in our process. Because if we get buy-in from the user then it ensures us that when we go to the market there will be a lot of buy-ins.” P 7: Case Study Seven.rtf - 7:6

4.13.8 Summary of External Experiments cross-case analysis

The cross-case analysis of external experiments to prove functional and market acceptance used by innovation leaders observed replication across the cases, as shown in Table 14 below. The analysis found that all successful innovation leaders conducted external experiments to determine the functional and market acceptance of new innovation projects.

Cross-case summary for external experiments used by innovation leaders	Case One	Case Two	Case Three	Case Four	Case Five	Case Six	Case Seven
External experiments proved functional acceptance	Yes	Yes	Yes	Yes	Yes	Yes	Yes
External experiments proved market acceptance	Yes	No	Yes	Yes	Yes	Yes	Yes

Table 14: Cross-case analysis of external experiments for innovation

4.14 Cross-case analysis of Research Question Five

Across the cases the principle of disciplined experiments has been used by innovation leaders to develop innovative solutions within their companies. Examples from the case studies were used to demonstrate these actions while answering Research Question Five. To avoid repetition of examples in the cross-case analysis repeated excerpts from the data are referenced back to where they appear in the research question.

4.14.1 Case Study One

Case Study One demonstrates the innovation leader’s use of disciplined experiments in the following ways:

Respondent One used disciplined experiments to ensure that the efficiency of their products met their initial assumptions.

“Initially, the tools we were using to develop the products were not as good as we had hoped at the time, the prediction and the performance were quite a bit out, so we addressed all the variances between the models. I must have done about 72 different iterations on the product, not on the computational side but actually, physically we would change certain parts of the product, so we did about 72 tests to get to the stage where we said okay, now we’re happy with the performance of the product.” P 1: **Case Study One.rtf - 1:42**

“I think we are very ethic people with an ethical base coming from a research background at the Research Company A. The guys we’ve hired were ex-colleagues of ours at the Research Company A.” P 1: **Case study 1.rtf - 1:47**

4.14.2 Case Study Two

Case Study Two demonstrates the innovation leader’s use of disciplined experiments in the following ways:

Respondent Two used disciplined experiments to ensure that the electronic building blocks and software development could be integrated into a single product.

“You have to have some methodologies in place whether it is agile, scrum or the waterfall method. When the product is so complex there are many fail points. You need checks and balances and quality control.” P 2: Case study 2.rtf - 2:39

4.14.3 Case Study Three

Case Study Three demonstrates the innovation leader’s use of disciplined experiments in the following ways:

Respondent Three used disciplined experiments to ensure that their products met the regulatory standards.

“In the coalmines you have to comply with the flame proof requirements. We are driven by our customers and the regulatory standards. We have the product certified to work under those conditions, there’s no room for hiding the truth it’s all upfront.” P 3: Case study 3.rtf - 3:32

4.14.4 Case Study Four

Case Study Four demonstrates the innovation leader’s use of disciplined experiments in the following ways:

Respondent Four used disciplined experiments to ensure that new products were approved through their internal stage gate process. To avoid repetition, the evidence is reported in section 4.5, Research Question Five (P 4: Case Study Four.rtf - 4:16)

“To approve the visual design we have the stage gate meeting where all the relevant stakeholders from within the group are represented. The entire top management structure from all the different divisions that are there. It is very difficult for one entity in the organisations to push his/her idea through it has got have the buy in from all the stakeholders.” P 4: Case study 4.rtf - 4:18

4.14.5 Case Study Five

Case Study Five demonstrates the innovation leader’s use of disciplined experiments in the following ways:

Respondent Five used disciplined experiments to ensure that the assumptions about initial ideas were tested by focus groups and refined.

“We tested a lot of the ideas in a kind of market testing perspective using focus groups.” P 5: Case study 5.rtf - 5:1

“The focus groups were a big part of where we started a lot of our assumptions from.” P 5: Case study 5.rtf - 5:2

“We tested the concept in terms of would people be interested in using it. From the feedback we continuously adjusted the way we positioned the product.” P 5: Case study 5.rtf - 5:3

4.14.6 Case Study Six

Case Study Six demonstrates the innovation leader’s use of disciplined experiments in the following ways:

Respondent Six used disciplined experiments to ensure that new software development was not unduly influenced by bias such as deadline pressure.

“A bias creeps in regardless and it always has to come down to challenging what it is you are looking to achieve at the start. If you set that out in a more or less clear fashion not necessarily how just the “what” and the “why”, the “why” in particular actually keeps you honest.” P 6: Case study 6.rtf - 6:23

“It is a constant battle throughout the process particularly in more difficult problems because you just get to a stage where you are looking for the path of least resistance. Part of the process is to make sure you do not run into bias as the process continues. I often pull the guys away and say look I know it’s urgent I know we need it by tomorrow but we are not serving ourselves if we run this thing through to tomorrow and not produce it properly.” P 6: Case study 6.rtf - 6:25

“Step back and leave it alone, come back in a day or two let us revisit it then. Both of those things help with bias.” P 6: Case study 6.rtf - 6:26

4.14.7 Case Study Seven

Case Study Seven demonstrates the innovation leader’s use of disciplined experiments in the following ways:

Respondent Team Seven used disciplined experiments to ensure that their medical product complied with the necessary safety regulations.

“I think being engineers and clinicians we tend to have a technology driven bias. But the external stakeholders bring us back to earth and say hang on the user need is this... so that is how we temper the bias. I think at the end of the day we have so many processes to be compliant to that we cannot afford to tamper with the result.” P 7: Case study 7.rtf - 7:22

4.14.8 Summary of Internal Experiments cross-case analysis

The cross-case analysis of the internal disciplined experiments used by innovation leaders observed replication across the cases, as shown in Table 15 below. The analysis

found that all innovation leaders used internal disciplined experiment to determine the truth about initial assumptions.

Cross-case summary for internal disciplined experiments used by innovation leaders	Case One	Case Two	Case Three	Case Four	Case Five	Case Six	Case Seven
Experiments determine truth about initial assumptions	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 15: Cross-case analysis of disciplined internal experiments for innovation

4.15 Cross-case analysis of Research Question Six

The principle of organisational structure for innovation has been presented in an exploratory manner observed from the actions of the innovation leaders. Examples from the case studies were used to demonstrate these actions while answering Research Question Six. To avoid repetition of the examples in the cross-case analysis, repeated excerpts from the data are referenced back to where they appear in the Research Question.

4.15.1 Case Study One

Respondent One demonstrates how he has successfully used the organisational structure to explore new solutions. In this small engineering firm, Respondent One is central to the organisational structure, which provides multiple roles for staff within the organisation. Respondent One's opinion is that multiple roles for staff are beneficial to the firm and are part of the reason that the international partner has invested in the firm.

“Because we're only a few people, we had to take on various roles, each of us.” P 1: Case Study One.rtf - 1:112

“We haven't really had the luxury with having our engineers for instance just falling under R&D into purely development work, being involved in the experimentation as well as being involved on the production side of the business.” P 1: Case study 1.rtf - 1:115

“So, it's a fairly flat structure. I would like to call him project manager, but he doesn't call himself a project manager, he just sees himself as one of the group, he's just managing the projects just by the way of what he's doing, so even there the thinking is a very flat structure.” P 1: Case study 1.rtf - 1:119

4.15.2 Case Study Two

Respondent Two reported that the innovation team functioned as a separate entity. The core innovation team was initially small, but grew during the project to meet the work and

deadline demands. The opportunity to innovate came from the parent company's investigation of internal know-how and intellectual property that had not been fully exploited.

"I am saying in a more formal environment like this corporate environment you will have to have an isolated organisational structure for innovation." P 2: Case study 2.rtf - 2:96

"The isolated organisational structure for innovation needs to learn. With funding we go and spend some time (three months) learning about electronic technology supplier C. So those are the kind of ways that we first bubble and then it can either become a product or it just becomes a module into that product." P 2: Case study 2.rtf - 2:21

4.15.3 Case Study Three

Respondent Three is the owner of this family-run business, creating a unique organisational structure. His autocratic management style allowed him to treat his product solutions and staff as an extension of his family. Each product was manufactured, sold and maintained through detailed lifecycle management approaches that informed the organisational structure and simultaneously provided opportunities to explore new solutions while exploiting existing ones.

"I think what makes our situation totally different is the fact that we're a family business. If my two sons weren't involved with me in the business, we would have a different team and management situation because I can pull them in any time of night, any time of day, over the weekend. You would not be able to do that with normal employees, so as a family business, in my opinion, we have a major advantage in that the core innovation team are family members." P 3: Case Study Three.rtf - 3:71

"Each product that we manufacture gets a unique serial number connected to that mine, connected to that application and everything that is involved with that project gets filed. When we get something new we will go back and review previous projects. We work through a lot of our old stuff just to ensure that we haven't forgotten something." P 3: Case Study Three.rtf - 3:104

"We review what worked in the past; each product has a nameplate and it's not the date of manufacture, it's the date born." P 3: Case Study Three.rtf - 3:105

4.15.4 Case Study Four

Respondent Four reported that innovation projects have led to numerous organisational changes over the past few years. Ultimately, this organisational journey of discovery has helped streamline the innovation process and develop an organisational structure that is efficient in exploring and exploiting opportunities. This efficient organisational structure provides guidelines for continuous innovation activities, allowing a number of projects to run simultaneously, supported by the strength of the business case. The organisational structure of the innovation team is well defined and fits in with the operational requirements of the organisation.

“From a business perspective, innovation initiatives tie up a huge amount of resources not just in terms of working capital but also space and operations capacity. Because innovation initiative ties up resources we have been forced to change how we innovate and develop new products into a more modular system so that we share components, we share platforms and we share functionality. From the business planning point of view, this approach eliminated a whole lot of working capital and uses less space in the assembly plant. Fitting in with the shared modular approach ensures assembled methods and time are optimised.” P

4: Case Study Four.rtf - 4:95

4.15.5 Case Study Five

Respondent Five explained how the organisational structure originated with the company founders and is known as the owner–manager culture. Business units are established with their own authority and ability to execute innovation. Business units have the flexibility to create their own organisational structure to address the purpose of the business unit. This protected space gives the innovation leader of the business unit an environment in which to develop new ideas to market fruition. New business units benefit from the protection mechanism provided by the company. This allows good ideas with sound business cases to develop and grow. However, new ideas still need to fit into the mandate of the company. The innovation leader and the business unit must justify the business case for new innovations.

“Based on the philosophy that comes from the company founders, which is ‘the owner–manager culture’, sets the basis for the business unit organisational structure. The owner–manager culture allows for the business unit managers who have control and accountability to also have the authority to execute. Which makes for a highly federated structure, that is a very agile structure as well and you have quick decision-making happening.” P **5: Case Study Five.rtf - 5:58**

4.15.6 Case Study Six

Respondent Six described that the organisational structure is relatively flat, consisting of only a few stakeholders, all of whom are involved in new innovation and operational matters. This small software services company aims to keep staff numbers to a minimum, which has been possible because of the generic nature of the company's innovative software. Having multiple roles for staff in the organisation has benefits in that the staff are constantly learning. The negative effect of having a small staff complement is the need to balance the workload between exploration and exploitation. This process is managed by Respondent Six, the innovation leader.

“Our company has a relatively flat organisational structure. You have obviously got senior executives, then senior management, the development team and the support team. Everybody at some stage of the process gets involved in innovation. The support team obviously because they are the most client facing. The development team because we understand the solution and executive management ultimately in order to ensure what we are building continues to move us into new markets and new countries.” P 6: Case study 6.rtf - 6:69

4.15.7 Case Study Seven

Respondent Group Seven demonstrated that their company's organisational structure allows for the exploration of new ideas and the assimilation of problems originating from their business environment in order to explore new innovative solutions. Respondents from Respondent Group Seven's explorative activities confirmed that their organisational structure is ambidextrous in nature, allowing for both exploration and exploitation. To avoid repetition, the evidence is reported in section 4.6, Research Question Three (P 7: Case study 7.rtf - 7:28 & 7:31)

4.15.8 Summary of Organisational Structure cross-case analysis

The cross-case analysis of the organisational structure used by innovation leaders observed replication across the cases, as shown in Table 16 below. The analysis found that all innovation leaders engage with their business environment and use the organisational structure in an explorative manner; the seven organisations thus demonstrate an ambidextrous organisational structure capable of exploitation and exploration.

Cross-case summary for organisation structures used by innovation leaders	Case One	Case Two	Case Three	Case Four	Case Five	Case Six	Case Seven
Exploratory organisational structure for innovation	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 16: Cross-case analysis of organisational structure for innovation

4.16 Cross-case analysis of Research Question Seven

The principle of planning for innovation has presented the need for learning to guide planning demonstrated by the actions of the innovation leaders. Examples from the case studies were used to demonstrate these actions while answering Research Question Seven. To avoid repetition of the examples in the cross-case analysis repeated excerpts from the data are referenced back to where they appear in the Research Question.

4.16.1 Case Study One

Respondent One knows that new knowledge helps the company to offer new solutions. Informed by this need for new learning, Respondent One's plans include testing, quality control and the purchasing of new equipment. He breaks the plan down into stages in order to measure and understand the progress being made and the direction in which these results will push the company. He uses regular meetings and software to track the progress of research and development activities.

“What we do is we work the milestones so that we'll have certain hold points on the project which I think are quite manageable and we know the timelines for that, so we've set very concrete milestones and say okay when we get to this point we'll make a decision to go further or not, or which route we're going to take. Then when we get to that point we'll define the next step, so it's controlled to some degree I think and we know where we're going in each step but we can't give you a final date on delivery. Yes, there's a need and a want and desire to get to market at a certain time before a competitor for instance but you know you can't clearly define those timelines.” P 1: Case study 1.rtf - 1:122

“The innovation team and as well as production, both of them use the same facilities, so I think there's a good understanding and planning of when what must be scheduled. When do we do tests for the development team and when we need tests for production and so I think the structure we have of the facility management by innovation guys does help to a certain degree to get the innovation stuff through the system as well, so they don't have to apply to the production team and say when can I use the test facility, it's part of the initial planning right from the

start.” P 1: Case study 1.rtf - 1:167

4.16.2 Case Study Two

Respondent Two’s planning covered the technical development of the innovation project. This required a plan for learning about new software and hardware technologies and how to integrate these separate components into one seamless product. This required Respondent Two to coordinate multiple development teams each focused on a separate piece of hardware or software technology. They combined the components and worked methodically through all the failure points until a reliable working solution was obtained.

“If you are planning to make a wow product that no one has seen before, you go and see how other people are doing things and then come back with that knowledge and add it to the learning curve.” P 2: Case Study Two.rtf - 2:99

4.16.3 Case Study Three

Respondent Three’s planning is based on learning about problems that the company’s customers are experiencing and how their solutions can solve these problems. The planning to provide customised solutions for each client requires close one-on-one relationships. These kinds of relationships helped Respondent Three to learn exactly when clients are likely to order new products, and also helped in planning the ongoing maintenance and servicing of products already supplied to customers.

“So, the great thing about that was you’ve been to your customer and you understand the problem and so you needed to come up with a solution.” P 3: Case study 3.rtf - 3:4

“When we get the order we go through the testing our planning plays a very big role to ensure we can get the product completed as fast as possible and ensure that we can prove the operation benefits to the customer.” P 3: Case study 3.rtf - 3:103

“It starts with the customer’s request then we plan out suggested solution for the customer and then it all stops until the order is placed.” P 3: Case study 3.rtf - 3:111

4.16.4 Case Study Four

Respondent Four reported that the planning process for innovation went through a number of experiments from which the company learned the fastest and most efficient planning process for innovation, coupled with a five to six-year roadmap of developments into the future. This streamlined planning process is used to learn about functional and market acceptance of new innovations through the planned stage gate process.

“Through a variety of experiments, we have learnt how to conduct those experiments faster and more effectively. We have got a roadmap of projects and

products looking forward about 5 to 6 years.” P 4: **Case Study Four.rtf - 4:50**

“When we have decided to go ahead with a particular innovation it goes through the stage gate process and within the stage gate process from the very beginning the first gate the senior management and executive of the organisation is involved there and that is where they give their support and approval to continue.” P 4: **Case study 4.rtf - 4:70**

4.16.5 Case Study Five

Respondent Five’s planning for innovation is informed by learning from customers, the vision and strategy of the company and new advancements in technology that can be exploited to solve customer problems. The initial plan includes a business case, which is used to assess the viability of the innovative new ideas. The business case includes regulatory compliance and other internal processes that are required by the organisation. To avoid repetition, the evidence is reported in section 4.7, Research Question Four (P 5: **Case study 5.rtf - 5:98 & 5:102**)

4.16.6 Case Study Six

Respondent Six plans innovation projects by balancing the workload between innovation and ongoing operations. This is done because the staff complement of the company is small and is shared between innovation and operational duties. The planning for innovation is not well defined other than to check that its goals are aligned with the vision of the company. Planning for innovation challenges conventional thinking, finding new ways to solve problems and produce software architecture that is flexible enough to add features as customers require them. New software development is planned by a small focused team and moved through a stage gate process to test and ensure that the planned objectives are met.

“So what we ended up doing we put a skunk works team together with three people and we sat down and we more or less mapped out key milestones for the project.” P 6: **Case study 6.rtf - 6:3**

“My planning job was to prioritise urgent and important issues. We have urgent problems to be solved in a balance with nice to have and important issues. All types of issues you want to add are significant because it sets the technical architecture that we are going to use. We need to be able to add onto this solution in a fairly quick and easy fashion from there we sit down and develop the architecture and code.” P 6: **Case study 6.rtf - 6:7**

4.16.7 Case Study Seven

The group of Respondents in Case Seven plan for innovation by learning from their competitors and from medical conferences, and by immersing themselves in customers' experiences of their products. Based on what is learned, new innovation projects are developed and tracked using a stage gate planning process.

“Being in the medical field we have a lot of competitors out there, so we constantly have to stay up to scratch with what they are doing and where we are in terms of that. Being a low-dose control machine is not going to be unique for much longer. So, we will have to find other ways of ensuring that our product fulfils the needs that other products do not. So constant learning, we have a competitor file which we constantly try and update to see what is out there to see what these people are doing and through that way you learn.” P 7: Case Study Seven.rtf - 7:77

4.16.8 Summary of Planning cross-case analysis

The cross-case analysis of the planning used by innovation leaders observed replication across the cases, as shown in Table 17 below. The analysis found that all innovation leaders engage with their business environment and used planning informed by learning.

Cross-case summary for planning used by innovation leaders	Case One	Case Two	Case Three	Case Four	Case Five	Case Six	Case Seven
Planning informed by learning	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 17: Cross-case analysis of planning for innovation

4.17 Cross-case analysis of Research Question Eight

The principle of teams for innovation has presented that blending dedicated and shared staff members, as demonstrated by the actions of the innovation leaders, produced effective results. Examples from the case studies were used to demonstrate these actions while answering Research Question Eight. To avoid repetition of these examples in the cross-case analysis, repeated excerpts from the data are referenced back to where they appear in the Research Question.

4.17.1 Case Study One

Respondent One hired innovative engineers who were driven to work on new innovation. He hired a mixture of experts with specific skills recognised by their industry, and young graduate engineers whom they trialled while finishing their studies. Respondent One

included operational staff members who contributed their operational knowledge and expertise. The innovation team was primarily made up of permanent staff.

“Because we’re only a few people, we had to take on various roles, each of us.” P

1: Case Study One.rtf - 1:112

“What drives the people we hire is coming up with new things, it’s very evident in a lot of the people we get on board and it’s just a philosophy in our business. It’s been there from the start.” P **1: Case Study One.rtf - 1:152**

4.17.2 Case Study Two

Respondent Two used a dedicated internal innovation team supported by multiple external development teams that contributed to the development of various pieces of the technology. The internal team consisted of a mix of dedicated and shared staff. Respondent Two used a team of fast-track innovators to move the project forward, supported by principled engineers who methodically ironed out the problems in the technology developed by the innovators.

“We had external teams in India, in Australia, in Cape Town, in Russia, in Germany and in the United States of America. We had an internal team of about 30 people. Altogether there were about 84 000 man-hours spent on this product.”

P 2: Case Study Two.rtf - 2:26

4.17.3 Case Study Three

Respondent Three’s family-led innovation team includes himself and his two sons. The family members were the core of the innovation team, with other staff members participating in innovation projects on a rotational basis. The innovation team did not have external members. Instead of directly involving external members, Respondent Three networked with local component suppliers and industry associations, which helped bring the latest technology to the company’s product solutions.

“I think what makes our situation totally different is the fact that we’re a family business. If my two sons weren’t involved with me in the business, we would have a different team and management situation because I can pull them in any time of night, any time of day, over the weekend. You would not be able to do that with normal employees, so as a family business, in my opinion, we have a major advantage in that the core innovation team are family members.” P **3: Case Study**

Three.rtf - 3:71

4.17.4 Case Study Four

Respondent Four has a dedicated innovation team made up of three types of team

members. Apart from the dedicated team, shared staff members are used during the innovation process. These shared members are brought in at the point where they can contribute to the project. External innovation team members are not used, as previous experience has shown that this approach does not work. To avoid repetition, the evidence is reported in section 4.8, Research Question Five (P 4: Case Study Four.rtf - 4:74, 4:77 & 4:78)

4.17.5 Case Study Five

Respondent Five's innovation team consists of core and shared staff members. Typically, the core innovation team members reside within the business unit, often recruited internally from other units based on their known innovative credentials. Shared staff are spread across other business units, which provide a service in helping to develop Respondent Five's innovation initiative. No external members are used. Innovation teams are made up of internal members. External members are only considered if they become permanent employees.

“It's all internal; we don't outsource innovation at all because we establish it as a business unit. The business case gets signed off. The team inside the business unit gets allocated to get this thing up and running.” P 5: Case Study Five.rtf - 5:87

“The innovation team consists of core and shared staff. How it worked say for example Service A, the implementation is always shared across Business Units (BU). To roll out Service A, we needed BU 1, BU 2, BU 3, BU 4 and BU 5. These are all separate teams' business units in their own right. The development of the information technology and the implementation aspect is shared and then your core that is inside your business unit and they are dedicated. With Service A we tried to keep the core as small as possible. We ended up with about sixty people, and that's a small business unit.” P 5: Case Study Five.rtf - 5:89

4.17.6 Case Study Six

Respondent Six reported that the innovation team and the operations team are the same people. The staff were shared across exploration and exploitation functions, which benefits the way in which they learn from customers. However, this approach limits the speed with which the company can innovate and service clients at the same time. External members are not used when using them would pose a threat to the company's intellectual property. External members are used in areas that do not compromise intellectual property. Students or external teams are used to code mundane everyday work.

“It is my job to be a lynchpin between clients, executive management and the staff of the company. I use our R&D to keep all three groups of stakeholders happy.

By producing tangible substantive products out of R&D, I am able to keep my development and support teams happy because they are not bored. It gives the executive management something to sell to new clients and the constant upgrades keep existent clients happy.” P 6: Case Study Six.rtf - 6:48

4.17.7 Case Study Seven

The respondents in Case Study Seven confirm that under their leadership as the core innovation team, they involve staff across the company in their innovation initiatives. They also use external members in the innovation team, including university students, research companies and industrial designers. The respondents also carefully select and hire new team members based on their ability to think critically.

“We try and cross-pollinate our staff quite a lot, for example, our services division was tasked to work in the factory putting machines together. We felt that this gives them the skills to service the machines and fault find and correct faults out in the field. We use customer-facing people and the development engineers as part of the innovation team.” P 7: Case Study Seven.rtf - 7:67

We have collaboration with UNIVERSITY A, we have a research program there that has been quite active over the last 10 years. We facilitate student projects, we come up with ideas and get student’s working on them. These become undergraduate or postgraduate projects. In the last three or four years we have some of these students in-house. So students will come and do vacation work testing the concept and producing results. P 7: Case study 7.rtf - 7:2

We needed to jazz up our machine because it looked very engineering. We got help from external experts, we approached some industrial designers to improve the look and interface of our machine. P 7: Case study 7.rtf - 7:68

4.17.8 .Summary of Innovation Team cross-case analysis

The cross-case analysis of the innovation teams used by innovation leaders observed several replications across the cases, as shown in Table 18 below. The analysis found that innovation leaders select innovation team members based on their capabilities, matching capabilities to development tasks. The data show that innovation leaders prefer selecting team members from among internal staff, and only select external members when the capabilities are absent in the organisation and when exposure to intellectual property is controlled. Not all cases follow the ideal mix of innovation teams set out by Govindarajan and Trimble (2010). The ideal mix reported by Govindarajan and Trimble (2010) included shared staff and dedicated staff, plus external members. In their

research in North America, they found that only a few companies used their suggested ideal mix, but all teams comprised a mixture of shared and dedicated staff.

Cross-case summary of the innovation team composition used by innovation leaders	Case One	Case Two	Case Three	Case Four	Case Five	Case Six	Case Seven
1. Used dedicated staff	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2. Used shared staff	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3. Used external dedicated team members	No	Yes	No	No	No	Yes	Yes

Table 18: Cross-case analysis of innovation team composition

4.18 Cross-case analysis of Research Question Nine

The principle of maintaining a positive relationship between ongoing operations and innovation initiatives has been achieved by innovation leaders who made effective use of the other principles. Examples from the case studies were used to demonstrate these actions while answering Research Question Nine. To avoid repetition of the examples in the cross-case analysis, repeated excerpts from the data are referenced back to where they appear in the Research Question.

4.18.1 Case Study One

The data summarised in Table 19 below demonstrated that Respondent One executes the promised potential of the new idea with the principles listed. In doing so, the innovation leader maintains a positive relationship between the ongoing operations of the company and the innovation initiatives. To avoid repetition, the evidence is reported in section 4.9, Research Question Nine (P 1: Case Study One.rtf - 1:171 & 1:104)

Case Study One: Innovation leader's positive relationship between ongoing operations and innovation initiatives through the execution of listed principles:	Principle observed Yes or No
External technology engagements	Yes
External market requirement engagements	Yes
External resource network engagements	Yes
Experimentation to prove functional and market acceptance	Yes
Exploratory organisational structure	Yes
Planning for organisational learning	Yes
Innovation team selection and management	Yes

Table 19: Case Study One: Innovation leader's positive relationship

4.18.2 Case Study Two

The data summarised in Table 20 below demonstrated that Respondent Two executed some of the promised potential of the new idea with the principles listed. However, the executed solution was only a functionally acceptable device. The content to be distributed by the new device and the way in which this business model would work were not included in Respondent Two's innovation project. This contributed to their lack of focus on the client's needs due to their initial assumption that they could sell the device to their 'business-to-business' customer (Customer A) and not the end-consumer. Instead, Customer A perceived this new technology as a threat and did not distribute the device and multimedia content through their established channels. As a further punitive action, Customer A reduced their orders of existing products from Case Study Two. This forced Case Study Two to distribute the device and multimedia content themselves directly to consumers.

"The technology offered by our new device led to Customer A reducing their order volumes of existing products. This negative impact on our company forced us to close down our research and development activities." P 2: Case Study Two.rtf - 2:75

Case Study Two: Innovation leader's positive relationship between ongoing operations and innovation initiatives through the execution of listed principles:	Principle observed Yes or No
External technology engagements	Yes
External market requirement engagements	No
External resource network engagements	Yes
Experimentation to prove functional and market acceptance	No
Exploratory organisational structure	Yes
Planning for organisational learning	Yes
Innovation team selection and management	Yes

Table 20: Case Study Two: Innovation leader's positive relationship

4.18.3 Case Study Three

The data summarised in Table 21 below demonstrated that Respondent Three executes the promised potential of the new idea with the principles listed. The potential for the exploitation of new ideas is realised by the innovation leader's execution of these principles. In doing so, the innovation leader maintained a positive relationship between the ongoing operations of the company and the innovation initiatives.

“I think we basically haven't got a senior management as far as the innovation is concerned. It's basically being a family business, basically me and my two sons.”

P 3: Case Study Three.rtf - 3:68

Case Study Three: Innovation leader's positive relationship between ongoing operations and innovation initiatives through the execution of listed principles:	Principle observed Yes or No
External technology engagements	Yes
External market requirement engagements	Yes
External resource network engagements	Yes
Experimentation to prove functional and market acceptance	Yes
Exploratory organisational structure	Yes
Planning for organisational learning	Yes
Innovation team selection and management	Yes

Table 21: Case Study Three: Innovation leader's positive relationship

4.18.4 Case Study Four

The data summarised in Table 22 below demonstrated that Respondent Four executes the promised potential of the new idea with the principles listed. The potential for the exploitation of new ideas is realised by the innovation leader's execution of these

principles. In doing so, the innovation leader maintains a positive relationship between the ongoing operations of the company and the innovation initiatives.

“We have specific forums at the company to discuss new and current development that we call value engineering.” **P 4: Case Study Four.rtf - 4:57**

“At the value engineering forum dedicated to discussing new product development, all the stakeholders in the organisation are involved. The value engineering forum has four streams: development and innovation, new product development linked to our company brands, the manufacture of products for other companies as well as quality control and other service-oriented developments.” **P 4: Case Study Four.rtf - 4:58**

Case Study Four: Innovation leader's positive relationship between ongoing operations and innovation initiatives through the execution of listed principles:	Principle observed Yes or No
External technology engagements	Yes
External market requirement engagements	Yes
External resource network engagements	Yes
Experimentation to prove functional and market acceptance	Yes
Exploratory organisational structure	Yes
Planning for organisational learning	Yes
Innovation team selection and management	Yes

Table 22: Case Study Four: Innovation leader's positive relationship

4.18.5 Case Study Five

The data summarised in Table 23 below demonstrated that Respondent Five executes the promised potential of the new idea with the principles listed. The potential for the exploitation of new ideas is realised by the innovation leader's execution of these principles. In doing so, the innovation leader maintains a positive relationship between the ongoing operations of the company and the innovation initiatives.

“We keep a positive relationship through stakeholder management with roadshows. At the roadshow, we present to everybody and explain to them what the innovation is, what it's about and why it's great. You consistently have to do these communications; stakeholder management and transparency is important.”

P 5: Case Study Five.rtf - 5:61

“The objective of the new business unit in your first year of operation is to deliver. Develop the new innovation and deliver on the promise created by the innovative idea. We use key performance indicators (KPI) to manage staff and that's what we measure and report on against the delivery goals.” **P 5: Case Study Five.rtf - 5:64**

Case Study Five: Innovation leader's positive relationship between ongoing operations and innovation initiatives through the execution of listed principles:	Principle observed Yes or No
External technology engagements	Yes
External market requirement engagements	Yes
External resource network engagements	Yes
Experimentation to prove functional and market acceptance	Yes
Exploratory organisational structure	Yes
Planning for organisational learning	Yes
Innovation team selection and management	Yes

Table 23: Case Study Five: Innovation leader's positive relationship

4.18.6 Case Study Six

The data summarised in Table 24 below demonstrated that Respondent Six executes the promised potential of the new idea using the principles listed. The potential for the exploitation of new ideas is realised by the innovation leader's execution of these principles. In doing so, the innovation leader maintains a positive relationship between the ongoing operations of the company and the innovation initiatives.

"We are fortunate that what we produce from R&D immediately goes into production. This ensures a positive relationship between ongoing operations and innovation initiatives." P 6: Case Study Six.rtf - 6:47

Case Study Six: Innovation leader's positive relationship between ongoing operations and innovation initiatives through the execution of listed principles:	Principle observed Yes or No
External technology engagements	Yes
External market requirement engagements	Yes
External resource network engagements	Yes
Experimentation to prove functional and market acceptance	Yes
Exploratory organisational structure	Yes
Planning for organisational learning	Yes
Innovation team selection and management	Yes

Table 24: Case Study Six: Innovation leader's positive relationship

4.18.7 Case Study Seven

The data summarised in Table 25 below demonstrated that Respondent Group Seven executes the promised potential of new ideas with the principles listed. The potential for the exploitation of new ideas is realised through the execution of these principles by the

group of innovation leaders. In doing so, the innovation leaders maintain a positive relationship between the ongoing operations of the company and the innovation initiatives.

“I think almost everyone is ultimately involved and so if we want to test, experiment with something on a machine then we would probably involve some of the production people because they would provide us with an actual system to test on.” P 7: Case Study Seven.rtf - 7:45

“With our customer-centricity focus, we want everyone to feel as if they are included in helping the customer have a better experience with our equipment. So, they are not just workers downstairs that just do what we tell them, they are part of the end result. That is enough motivation for them to not mind to assist with these constant changes and constant innovations knowing that they are part of the bigger picture and they are being included.” P 7: Case Study Seven.rtf - 7:48

Case Study Seven: Innovation team’s positive relationship between ongoing operations and innovation initiatives through the execution of listed principles:	Principle observed Yes or No
External technology engagements	Yes
External market requirement engagements	Yes
External resource network engagements	Yes
Experimentation to prove functional and market acceptance	Yes
Exploratory organisational structure	Yes
Planning for organisational learning	Yes
Innovation team selection and management	Yes

Table 25: Case Study Seven: Innovation team’s positive relationship

4.18.8 Summary of Positive Relationship cross-case analysis

The cross-case analysis of the positive relationship between ongoing operations and innovation initiatives that innovation leaders build observed several replications across the cases, as shown in Table 25. The analysis found that the activities of innovation leaders – technology, market requirements, external resource networks, experimentation, organisational structure, planning, selection and management of innovation teams – contributed to a positive relationship between ongoing operations and innovation initiatives. The effective execution of these principles helped innovation leaders to establish a compelling business case for new innovations, thereby gaining support from ongoing operations and the organisation. In almost all cases, innovation leaders replicate this set of activities and behaviour. Case Study Two was an exception in that it was identified as a negative case in which the innovation project failed and was withdrawn from the marketplace.

Cross-case summary of innovation leaders maintaining a positive relationship between ongoing operations and innovation initiatives by executing the listed principles	Case One	Case Two	Case Three	Case Four	Case Five	Case Six	Case Seven
1. Use of technology	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2. Determine market requirements	Yes	No	Yes	Yes	Yes	Yes	Yes
3. Used external resource network	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4. Proving functional and market acceptance	Yes	No	Yes	Yes	Yes	Yes	Yes
5. Disciplined experiments	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6. Organisational structure	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7. Planning	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8. Team composition	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 26: Cross-case analysis of positive relationship for innovation

4.19 Summary of data analysis

In summary, the question-and-answer analysis and cross-case analysis formats confirmed that all the listed principles contributed to the actions of successful innovation leaders in South African companies (Table 26). Chapter 5 presents the discussion and interpretation of the data analysis presented in Chapter 4.

Cross-case summary of principles for innovation leadership	Case One	Case Two	Case Three	Case Four	Case Five	Case Six	Case Seven
1. Use of technology	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2. Determine market requirements	Yes	No	Yes	Yes	Yes	Yes	Yes
3. Use of external resource network	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4. Proved functional and market acceptance	Yes	No	Yes	Yes	Yes	Yes	Yes
5. Disciplined experiments	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6. Organisational structure	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7. Planning	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8. Team composition	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9. Maintained positive relationship between innovation and operations	Yes	No	Yes	Yes	Yes	Yes	Yes

Table 27: Cross-case summary of principles for innovation leadership

Chapter 5: Discussion and interpretation of data

In Chapter 5, the replications identified in Chapter 4 are discussed in greater detail in order to interpret the replications presented. Each of the principles is discussed in combination with the existing literature and rival explanations posed prior to data collection. Finally, each principle is interpreted with reference to the research question, the theoretical proposition and the research sub-purpose related to the principle. The process diagram shown in Figure 28 provides a visual summary of the logic used in the cross-case analysis reporting format.

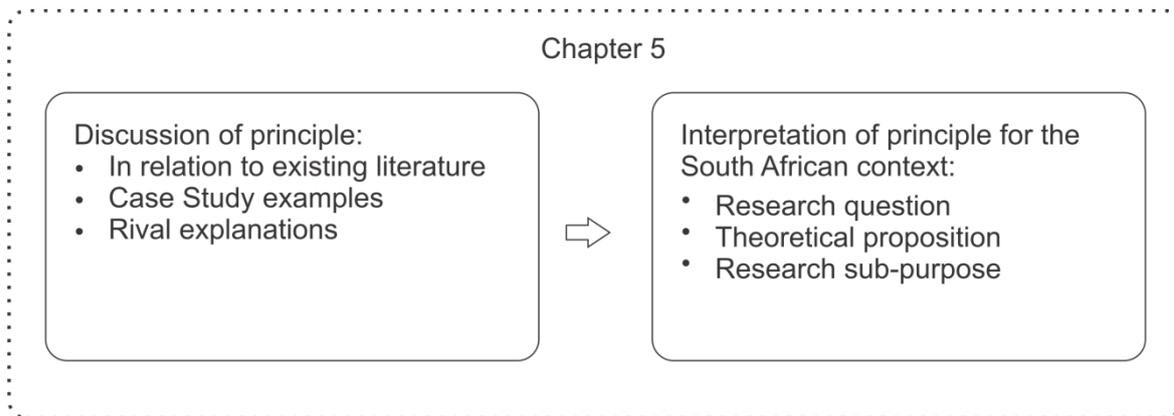


Figure 28: Reporting format logic for Chapter 5

5.1 Technology

The principle of technology has been used by successful South African innovation leaders across all cases.

Organisational learning theorists such as Argote and Miron-Spektor (2011) maintain that learning from the external environment of the organisation is essential. Furthermore, they argued that the context of the external environment has a significant impact on how the organisation experiences the external environment and thus impacts on the knowledge created from these experiences (Argote and Miron-Spektor 2011). Case Study Three, for example, demonstrated how the innovation leader learnt from his external business environment by servicing faulty mining equipment. In doing so, he learnt from this environment the causes of equipment failures. He also learnt about the procurement and maintenance problems that existed and how these issues negatively affected operational costs due to downtime caused by faulty equipment and the lengthy procurement and maintenance procedures.

Design management theorists such as Fernández-Mesa et al. (2013) argue that successful innovation initiatives rely on organisational learning that includes interaction

with external environments. The adaptation of the firm to the changing external environment provides new problems to solve, creating new opportunities for innovation. Respondent Three, for example, using what he had learnt from the business environment was able to come up with new ideas on how to solve the problems created by faulty mining equipment. Respondent Three solved the problems by using existing material technology and incorporating these materials into mechanical design improvements, resulting in more durable products.

The notion that South African innovation leaders used technology as a *means* to develop successful innovative products and services is supported by the existing literature. Technology is identified as one of the established *means* attributes of the multidisciplinary definition of innovation in the business realm (Baregheh et al. 2009), as discussed in subsection 2.1.1. Technology is a key attribute of the “first-order” design and problem-solving process, which relies on scientific knowledge and engineering (Krippendorff and Butter 1984; Krippendorff and Butter 2007), as discussed in subsection 2.2.6. The investigation of the innovation process over time has identified technology as an essential contributor to innovation. In the 1950s, the “technology push” process of innovation was observed (Rothwell 1994: 8), as discussed in subsection 2.4.2. Technology remains an essential *means* of innovation in contemporary descriptions of the innovation process, such as the closed and open innovation process models described by (Chesbrough 2012), as discussed in subsection 2.4.2.

In the emerging economic *social context*, monitoring and using technology is shown to contribute to innovation (Bruton et al. 2013). Oerlemans et al. (2005), who specifically studied innovative companies in South Africa, concur with the findings of Bruton et al. (2013) that South African companies that monitor and use technology performed better when introducing innovative products and services, as discussed in subsection 2.5.2. These studies showed that leading innovative South African companies follow technology trends and use technology to improve competitiveness, whereas Blankley and Moses (2009) found that the majority of South African companies were reluctant to experiment with technology, as discussed in subsection 2.3.3.

As part of the process of reaching a reliable interpretation of the data, rival explanations are discussed to ensure conformability, as described in more detail in subsection 3.2.6. Criteria for research quality.

The rival explanation posed for the use of technology by innovation leaders was:

Alternatively, the innovation leaders did not use the means of technology in the local social context to develop innovative solutions.

Evidence from the literature review and the cross-case analysis in Table 11 (section 4.10) disputes this rival explanation. In all cases, the data confirmed that innovation leaders did use the principle of Technology as a *means* to solve problems and create new value for the company, as demonstrated from the *social context* of Respondent Three, who produced durable products with specialised materials technology.

5.1.1 Summary of Research Question One:

How do the innovation leaders' technology learning engagements with their social context contribute to innovation projects?

...and Theoretical Proposition One:

Innovation leaders used the means of technology in the local social context to help develop innovative solutions.

...which demonstrated that successful innovation leaders' synthesis of existing technologies made a significant contribution to the execution of successful innovation projects. The data did not demonstrate that South African innovation leaders or their companies conducted fundamental research to develop new technologies. Conversely, companies rather synthesised existing technologies to create new innovative product and service offerings.

In answering Research Sub-Purpose One:

To determine how innovation leaders' used technology as a means in their local social context to create successful innovation initiatives, thereby determining the contribution for the technology means to the model for innovation leadership in South African companies.

The data gathered from the seven cases demonstrate that the principle of technology plays a significant role in the practice of successful South African innovation leaders; in particular, the synthesis of existing technologies demonstrated how the technology principle was applied in the model for innovation leadership in South African companies.

5.2 Market requirements

The principle of market requirements has been used by successful South African innovation leaders across all six successful cases.

The notion that successful innovation leaders engaged with their business environment to learn about market requirements is supported by the literature on organisational learning and strategic decision-making. Organisational learning provides an ability to learn from external environments and use this knowledge to adapt to these environments, ensuring performance and long-term success of organisations (Argote and Miron-Spektor 2011). Respondent Four, for example, demonstrated how she engaged with her business environment to provide market evidence including the profit potential for the new innovation initiative. Her financial motivations were based on external factors such as the economic climate, merchant pricing strategies and comparisons with competitor product pricing and quotations.

The strategic decision-making of senior and middle management considers various characteristics influencing innovation exploitation decisions (Behrens et al. 2014). External environment characteristics included in these decisions are the context relative to competitors' marketplace adoption of technology and market demand (Behrens et al. 2014). Respondent Four demonstrated how she monitored her company's position relative to their competitors. She continually collected evidence on market adoption of technology with photographs and insights from merchants and architects. Respondent Four also gauged market demand by gaining insights from merchants who sell their products.

The rival explanation posed for the use of market requirements by innovation leaders:

Alternatively, the innovation leaders did not use the means of market requirements in the local social context to develop innovative solutions.

The literature on organisational learning and strategic decision-making for innovation plus the data from the cross-case analysis in Table 12 (section 4.11) disputes this rival explanation. In all six successful cases, the data confirm that innovation leaders did use the principle of market requirements to guide the development of new innovative ideas, as demonstrated by Respondent Four who showed her management of the profit potential supported by market evidence from external sources. In contrast, Respondent Two reported that he did not use the principle of market requirements to guide the development of the innovative idea. Instead Respondent Two reported that his company planned to exploit existing patents and used external consultants to provide potential market scenarios on which to base their initial business case.

5.2.1 Summary of Research Question Two:

How do the innovation leaders' market requirements learning engagements with their social context contribute to innovation projects?

...and Theoretical Proposition Two:

Innovation leaders used the means of market requirements in the local social context to help develop innovative solutions.

...which demonstrated that successful innovation leaders' use of either proactive or reactive learning of market requirements made a significant contribution to the execution of successful innovation projects. The data demonstrated that the *means* of market requirements learning followed a proactive approach in cases where new synthesis of existing technologies took place. In Case Study Four where the technology was stable, innovation was introduced through new aesthetic styling in a reactive approach to competitors and market demand for new stylistic options.

In answering Research Sub-Purpose Two:

To determine how innovation leaders' established market requirements as a means in their local social context to create successful innovation initiatives, thereby determining the contribution of the market requirements means to the model for innovation leadership in South African companies.

The data gathered from the seven cases demonstrate that the principle of market requirements played a significant role in the practice of successful South African innovation leaders. Five cases used a proactive approach to learning about market requirements, which they used to create new products and services to differentiate themselves from their competitors. One case (Case Study Four) used a reactive approach to learning about market requirements, allowing them to compete and remain abreast of their competitors. One case (Case Study Two) did not learn about the market requirements and instead used the advice of external consultants. The product and services it provided failed commercially, because the market requirement for multimedia content was not provided as expected by the market. Both proactive and reactive learning demonstrated how the market requirement principle was applied in the model for innovation leadership in South African companies.

5.3 Resource networks

The principle of resource networks has been used by successful South African innovation leaders across all cases.

The notion that successful innovation leaders used external resource networks to help develop innovation initiatives is supported by the literature on fifth generation innovation processes and open innovation processes (Rothwell 1994; Chesbrough 2012). The concepts of fifth generation innovation and open innovation entail greater access to technologies, and reduce development time and cost by including external resources in the development of new innovations (Rothwell 1994; Chesbrough 2012). In Case Study Six, for example, Respondent Six used the internet and smart phones as key external resources by integrating SMS, e-mail notification and websites into their inventory management service. The “outside-in” approach was applied to these external resources, allowing Respondent Six and his company to control internally how these external resources were applied to their innovative solutions.

The rival explanation posed for the use of the external resource network principle by innovation leaders:

Alternatively, the innovation leaders did not use the means of resource network innovation in the local social context to develop innovative solutions.

The literature on open innovation processes and the data from the cross-case analysis in Table 13 (section 4.12) disputes this rival explanation. In all seven cases, the data confirm that innovation leaders did use the *means* external resource networks to develop innovation initiatives, as demonstrated by Respondent Six who developed new inventory management software to take advantage of the internet as an external resource. Using the internet as part of their solution allowed inventory management to be distributed over multiple sites. Involving smart phones extended the inventory management reach to all areas where mobile data communication was covered.

5.3.1 Summary of Research Question Three:

How do the innovation leaders’ external resource network learning engagements with their social context contribute to innovation projects?

...and Theoretical Proposition Three:

Innovation leaders used the means of resource network innovation in the local social context to help develop innovative solutions.

...which demonstrated that successful innovation leaders’ use of external resource networks in an “outside in” manner made a significant contribution to the execution of successful innovation projects. The data demonstrated that the *means* of external resource network learning followed by all cases was the “outside-in” approach. None of

the cases used the “Inside-out” approach, which relies on external partners using the technology platform provided by the innovative case study company.

In answering Research Sub-Purpose Three:

To determine how innovation leaders’ used their external resource network as a means in their local social context to create successful innovation initiatives, thereby determining the contribution for the external resource network means to the model for innovation leadership in South African companies.

The data gathered from the seven cases demonstrate that the principle of external resource networks using the “outside-in” method played a significant role in the practice of successful South African innovation leaders. All cases used the “outside-in” method to learn about and use external resource networks, as this approach helped to significantly reduce the need to create and maintain these resources within the company. Making use of external resource networks furthermore reduced the development time required to make new products and services, as demonstrated by Respondent Six who used the available networking capabilities provided by the internet and cellular telephone networks. The “outside-in” method of external resource network was applied in the model for innovation leadership in South African companies.

5.4 Integration through experimentation

Research Questions Four and Five investigate external and internal experimentation respectively. Both Research Questions Four and Five are discussed and interpreted in this section. The principle of experimentation has been applied by successful South African innovation leaders for both internal and external learning across all cases. In addition to the principle of internal disciplined cause-and-effect experimentation occurring in all cases, two distinct external types of experimentation were observed. South African innovation leaders used the principle of external experimentation to run tests that helped to determine the functional and market acceptance of new innovative ideas. These experiments are discussed in relation to the existing literature and the rival explanations posed prior to data collection. The processes applied to the principle of experimentation are then illustrated.

5.4.1 Experiments to prove functional acceptance

The notion that successful innovation leaders used experiments to prove that the innovative solution met the expected functional requirements is supported by the literature on quantitative experimentation. Quantitative experiments that include the design, building and testing of prototypes for the innovative solution provide a range of internal

and external interaction for the innovation leader and his or her team to test, refine and prove functional acceptance in a disciplined cause-and-effect manner. For example, Marion and Simpson (2009) determined that the key drivers of quantitative experimental success included team communication, computer aided design (CAD) efficiency and physical prototyping iterations. Bogers and Horst (2014) demonstrated that collaborative prototyping spans organisational boundaries and improves knowledge creation and transfer. The process of prototyping reduces boundaries between designers, managers and other internal and external stakeholders (Bogers and Horst 2014). In Case Study Four, for example, Respondent Four conducted technical experiments to prove that her company's sanitary ware products met the regulatory specifications required by their industry. In such cases, the factory-manufactured prototypes are tested against the specification norms. The notion that successful innovation leaders used the principle of experimentation to obtain functional acceptance criteria is supported by the literature on organisational learning. In sections 5.1, 5.2, 5.3 and 5.4 it has been established that organisational learning includes learning from the external environment (Argote and Miron-Spektor 2011). The external environment includes industry regulations and standards to control the quality and safety of products and services. In Case Study One, for example, Respondent One learned about the industry standards that applied to the functional performance and safety of similar products used in the mining industry. Respondent One used these standards obtained through his engagement with the business environment to determine baseline measurements that he could use while experimenting with new solutions.

5.4.2 Experiments to prove market acceptance

The notion that successful innovation leaders used experiments to prove that the innovative solution met the expected market requirements is supported by the literature on qualitative experiments. Qualitative experiments have investigated users of product and service solutions and conduct experiments to determine how and why consumers were motivated to choose and use these products and services in a disciplined cause-and-effect manner. For example, Hauser et al. (2014) discussed techniques of self-reflection on the interactions and experiences created by innovation scenarios with prototypes and visualisations. In Case Study Four, for example, Respondent Four produced three-dimensional (3D) printed models that replicated the final product. She sent the 3D printed model with a questionnaire to external experts such as architects, merchants and international partners to determine their acceptance of the new design direction. She consolidated their feedback and presented the external experts' opinion to management at the relevant stage gate meeting. The organisational learning literature

supported the notion that successful innovation leaders used the principle of experimentation to obtain market acceptance criteria. Argote and Miron-Spektor (2011) proved that organisational learning includes learning from the external environments. The external environment includes the customers or users of products and services, who have their own set of expectations on how products and services are consumed. In Case Study One, for example, Respondent One also used his external environment to learn about the market requirements of the South African power utility (Eskom), which called for projects that improved energy efficiency in major industries to better utilise the existing electrical power capacity in the country.

The rival explanation posed for the use of disciplined cause-and-effect internal and external experiments was:

Alternatively, the innovation leaders did not use experimentation to integrate technology, market requirements and resource networks in the local social context to develop innovative solutions.

Alternatively, innovation leaders did not use internal disciplined experimentation in the local social context to determine the truth about assumptions made about the new innovative solution.

The literature on qualitative experiments to learn about consumer acceptance (subsection 2.5.3) plus the evidence from the cross-case analysis in Table 14 and 14 (sections 4.13 and 4.14) dispute this rival explanation. In all six successful case studies, the data confirmed that the innovation leader used disciplined cause-and-effect internal and external experimentation to prove market acceptance of the new innovative solution, as demonstrated by Respondent One who designed experiments to gain market acceptance feedback from external experts for the new energy-efficient solutions that they planned to manufacture and sell.

The literature on quantitative experimentation (subsection 2.5.3) plus the evidence from the cross-case analysis in Table 14 and 14 (sections 4.13 and 4.14) dispute this rival explanation. In all seven cases, the data confirm that the innovation leader used experimentation to prove functional acceptance of the new innovative solution, as demonstrated by Respondent Four who use functional experiments to prove that their new product solution met the industry standard for water flow rate and water pressure ratings.

In contrast, Respondent Two did not conduct any market acceptance experiments, as market acceptance was assumed by senior management on the basis of external

consultants' reports. The parent company pushed forward the opportunity to innovate without developing an in-depth understanding of the client for this technology. Instead of supporting the in-house innovation team, the parent company enlisted the help of consultants to establish the market objectives of the innovation project. The capabilities of the in-house innovation team allowed Respondent Two to build a technically sound innovative solution; however, using consultants employed by the parent company failed to provide a compelling scenario for the way in which this new technology would be absorbed by the target market. In the end, the innovation failed and was withdrawn from the marketplace amidst criticism that the company had focused on the technology rather than the multimedia content that drove consumer demand in the industry.

5.4.3 Experimental process

The experimental process depicts the iterative nature of experimentation, the orchestration of the innovation leader and the outcome of a functional and market-tested solution. For example, the respondent in Case Study One led the company through a rigorous experimental process, which involved a cyclical process of experiments of functional performance and market acceptance of the new innovation, recording of assumptions, building and testing various models, measuring the results and refining the initial assumptions.

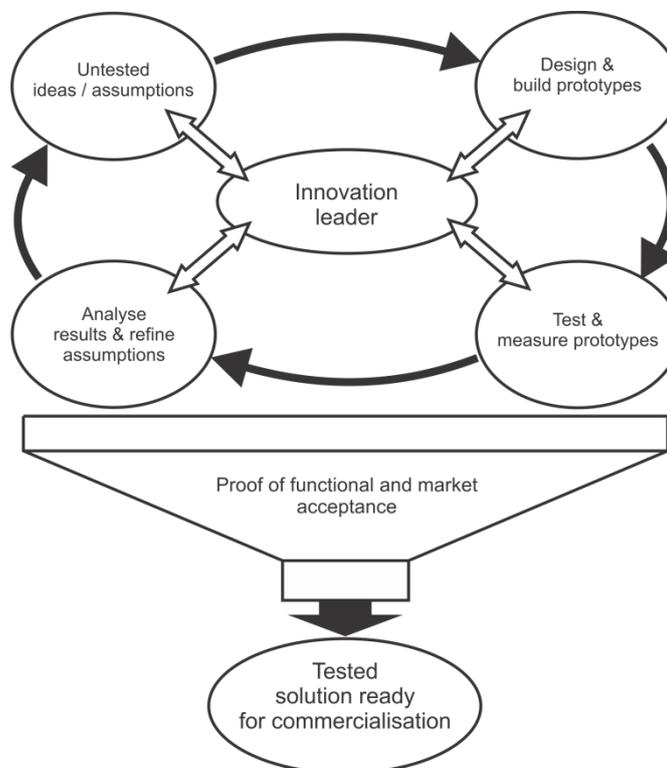


Figure 29: Disciplined internal and external experimentation Source: Author

The conceptual model shown in Figure 29 illustrates how the innovation leader plays a central role in ensuring that all aspects of the iterative experimental process are conducted until sufficient proof for functional and market acceptance has been achieved.

5.4.4 Summary of Research Questions Four and Five:

How do the innovation leaders' external experiments with technology, market requirements and resource networks from their social context integrate with innovation projects?

How do disciplined internal experiments orchestrated by the innovation leaders contribute to new solutions?

...and Theoretical Propositions Four and Five:

Innovation leaders used experimentation to integrate technology, market requirements and resource networks learning in the local social context to develop innovative solutions.

Innovation leaders used internal disciplined cause-and-effect experimentation in the local social context to seek the truth about assumptions made with respect to the innovative solutions.

...which demonstrate that successful innovation leaders do use disciplined cause-and-effect experimentation across internal and external boundaries to learn about and refine innovative solutions that are under their management.

In answering Research Sub-Purposes Four and Five:

To determine how innovation leaders' integrated external technology, market requirements and external resource networks means in their local social context through a process of experimentation, thereby developing an understanding of how experimentation contributes to the model for innovation leadership in South African companies.

To determine whether innovation leaders' used disciplined unbiased cause-and-effect experiments in their social context, thereby confirming or disputing whether internal disciplined cause-and-effect experiments contribute to the model for innovation leadership in South African companies.

The data gathered from the seven cases demonstrates that successful South African innovation leaders used the principle of disciplined experimentation with the multiple

objectives of proving functional and market acceptance for the innovative solution. Including the principle of experimentation with the dual objective of functional and market acceptance into the model for innovation leaders in South African companies may help to guide and develop their practice, as South African innovation leaders are acknowledged to have limited proficiency for routine and difficult innovation due to the specific emerging economy context.

5.5 Organisational structure

The principle of organisational structure for innovative initiatives has been used by successful South African innovation leaders across all cases. It was observed that innovation leaders used organisational structure in an exploratory manner as predicted by the literature on ambidextrous organisational structures. The literature on ambidextrous organisational structure has determined that exploratory organisational structures are used to develop innovative initiatives (Govindarajan and Trimble 2010; Scott 2014). Exploratory organisational structures differ from exploitative organisational structures as they are focused on very different tasks (Govindarajan and Trimble 2010). Exploratory structures seek to learn and create new commercial opportunities, while exploitative structures focus on efficiently extracting value from existing commercial opportunities (Govindarajan and Trimble 2010). In Case Study Seven, for example, the group of respondents was involved in changing the organisational structure to explore the needs of their stakeholders and ensure that their company remained relevant to the needs of their external stakeholders.

The rival explanation of exploratory organisational structure for innovative initiatives was:

Alternatively, innovation leaders do not use an exploratory organisational structure in the local social context to develop innovation initiatives.

The literature on ambidextrous organisational structure and the data collected from the cross-case analysis in Table 16 (section 4.15) dispute this rival explanation. In all seven cases, the data confirm that the innovation leader used an exploratory organisational structure for the development of innovation initiatives. Respondent Team Seven demonstrated the use of an exploratory organisational structure to engage with hospitals, doctors, clinicians and patients using their products. Staff from various departments within the organisation were involved in gaining insights from external stakeholders to help grow the company.

5.5.1 Summary of Research Question Six:

How do organisational structures used by innovation leaders move innovation activities forward?

...and Theoretical Proposition Six:

The innovation leaders' understanding of problems from the local social context are assimilated into the organisational structure to explore innovative solutions.

...which confirm that successful South African innovation leaders used the principle of exploratory organisational structure for innovative initiatives, as demonstrated by research undertaken in First World economies by Govindarajan and Trimble (2010).

In answering Research Sub-Purpose Six:

To determine whether innovation leaders' used explorative organisational structures allowing them and their assigned personnel and resources to explore new ideas in their social context, thereby confirming or disputing whether ambidextrous organisational structures contribute to the model for innovation leadership in South African companies.

The data gathered from the seven cases demonstrated that the principle of organisational structure for innovative initiatives did allow innovation leaders and their teams to explore new ideas, thereby confirming that this principle applies in the South African economic context and is not only suitable for the context of First World economies.

5.6 Planning

The principle of planning for innovative initiatives has been used by successful South African innovation leaders across all cases. It was observed that innovation leaders used planning informed by the need for learning and the creation of new knowledge as predicted by the literature on organisational learning. The literature on organisational learning has determined that acquiring and using new knowledge is essential to the process of innovation in existing businesses (Govindarajan and Trimble 2010). Planning for innovation differs from the planning used in ongoing operations, as innovation requires learning (validity orientation) while ongoing operations require previous sales and operations data (reliability orientation), as described by Martin (2007). In Case Study Five, for example, Respondent Five planned for innovation based on what they had learned from their customer call centre and how they could address their customer needs with new cellular phone technology.

The rival explanation for planning of innovative initiatives was:

Alternatively, innovation planning is based on the planning strategies used by the ongoing operations of the organisation.

The literature on organisational learning and the data collected from the cross-case analysis in Table 17 (section 4.16) dispute this rival explanation. In all seven cases, the data confirm that the innovation leader used planning informed by the need to learn for the development of innovation initiatives. Respondent Five demonstrated the use of planning to learn how cellular phone-based applications could be used to provide their clients with new financial services to address complaints received through their call centre.

5.6.1 Summary of Research Question Seven:

How does the innovation leaders' planning, informed by organisational learning, guide the innovation process?

...and Theoretical Proposition Seven:

The planning implemented by innovation leaders for innovation initiatives in the local social context includes the pursuit of organisational learning, which stems from the innovation leaders' understanding of solvable problems from the local social context.

...which confirm that successful South African innovation leaders used the principle of planning for innovative initiatives informed by learning, as demonstrated by research undertaken in First World economies by Govindarajan and Trimble (2010).

In answering Research Sub-Purpose Seven:

To determine whether organisational learning linked to internal and external engagements of the innovation leader is an appropriate planning strategy for innovation initiatives in their social context, thereby confirming or disputing whether planning using a combination of internal and external learning contributes to the model for innovation leadership in South African companies.

The data gathered from the seven cases demonstrated that the principle of planning for innovative initiatives did allow innovation leaders and their teams to learn from the exploration of new ideas, thereby confirming that this principle applies in the South African economic context and is not only suitable for the context of First World economies.

5.7 Team composition

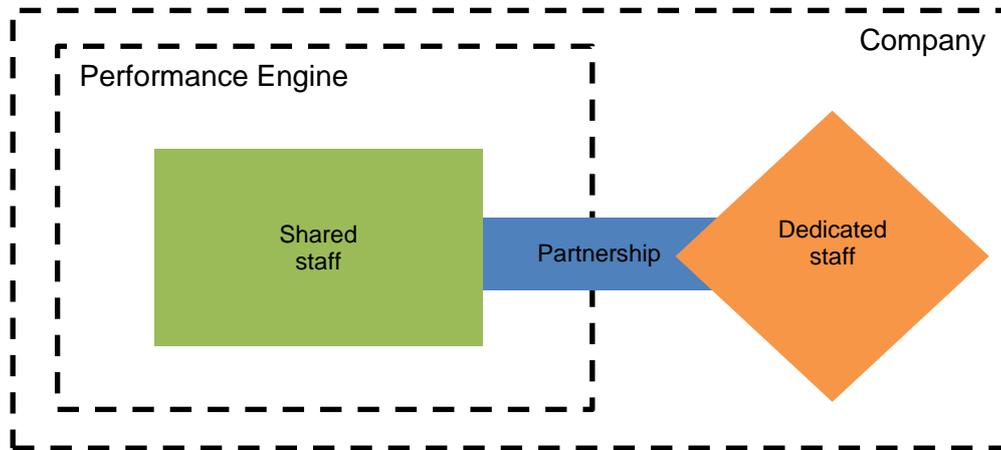
The principle of team composition for innovative initiatives has been used by successful South African innovation leaders across all cases. It was observed that innovation leaders used team composition in the manner prescribed by Govindarajan and Trimble (2010), who determined that innovation teams were comprised of dedicated and shared staff. The combination of dedicated and shared staff helps drive innovation initiatives forward while ensuring that these initiatives remain aligned with the experiences and capabilities of the organisation (Govindarajan and Trimble 2010). In Case Study Four, for example, Respondent Four demonstrated a mix of dedicated and shared staff members. Her dedicated team included designers, engineers and draftsman, while shared staff typically came from the categories of managers, sales and quality control.

The rival explanation for the composition of teams for innovative initiatives was:

Alternatively, the mix of internal staff and external members in the local social context used by the innovation leader has no effect on the performance of the innovation initiative.

The literature on innovation team composition and the data collected from the cross-case analysis in Table 18 (section 4.17) dispute this rival explanation. In all seven cases, the data confirm that the innovation leader used innovation teams comprised of dedicated and shared staff members. Respondent Four demonstrated that her use of dedicated and shared staff members drove innovation forward within the bounds of the capabilities and resources of the organisation.

The model presented by Govindarajan and Trimble (2010), as shown in Figure 22 (repeated below) illustrates how innovation leaders use a mixture of dedicated and shared staff to guide the exploration of innovative initiatives. Govindarajan and Trimble (2010) refer to the ongoing operations of the organisation as the “Performance Engine” from which shared staff are borrowed to help guide innovation initiatives.



Repeat of Figure 22: Team structure for innovation projects (Govindarajan and Trimble 2010: 28)

5.7.1 Summary of Research Question Eight:

How do the innovation leaders' selection and management of innovation team members provide a suitable mix of competencies to drive innovation?

...and theoretical proposition Eight:

The innovation leaders' composition of an innovation team in the local social context is made up of internal staff and external members to drive innovation forward.

...which confirm that successful South African innovation leaders used the principle of innovation team composition for innovative initiatives, as demonstrated by research undertaken in First World economies by Govindarajan and Trimble (2010).

In answering Research Sub-Purpose Eight:

To determine whether the selection and management of innovation team members used by the innovation leader follow Govindarajan and Trimble's (2010) model of team composition in their social context, thereby confirming or disputing the applicability of their model of team composition to the model for innovation leadership in South African companies.

The data gathered from the seven cases demonstrated that the principle of team composition for innovative initiatives did follow the model presented by Govindarajan and Trimble (2010) allowing innovation leaders and their teams to successfully explore new

ideas thereby confirming this principle applies in South African economic context and is not only suitable for First World economic contexts.

5.8 Positive relationship between ongoing operations and innovation initiatives

The principle of maintaining a positive relationship between ongoing operations and innovation initiatives has been used by successful South African innovation leaders across all cases. It was observed that innovation leaders used positive relationship as described by Govindarajan and Trimble (2010). Govindarajan and Trimble (2010) explained that maintaining a positive relationship between ongoing operations and innovation initiatives addresses the fundamental paradox experienced by existing organisations that tend to focus on operational exploitation of their current competitive advantage and not on innovation initiatives. In Case Study One for example Respondent One used the other principles to justify and maintain a positive outlook for innovation initiatives by delivering on the promised potential of high efficiency energy saving mining equipment.

The rival explanation for maintaining a positive relationship between ongoing operations and innovative initiatives is:

Alternatively, the innovation leaders did not use these principles – technology, market requirements, resource networks, integration of internal and external experimental learning, organisational structure, planning and the selection and management of the innovation team in the local social context – to report to senior management on the status of innovation projects.

The literature on the maintenance of positive relationships between ongoing operations and innovation initiatives plus the data collected from the cross-case analysis Table 26 in section 4.18 disputes this rival explanation. In all six successful cases the data confirms that the innovation leader maintained a positive relationship between ongoing operations and innovation initiatives. Respondent One engaged with technology, market requirements, external resource networks, used an exploratory organisational structure, planned base on learning, managed a team comprised of dedicated and shared staff and ran disciplined internal and external experiments to establish functional and market acceptance. The process of innovation applied by the innovation leader developed new high-efficiency mining equipment that delivered on the promise created by the new idea, thereby maintaining a positive relationship between ongoing operations and innovation initiatives.

In contrast, Respondent Two failed to maintain a positive relationship between innovation and ongoing operations. Respondent Two did not develop the initial business case based on the market requirements; instead the parent company used market requirement scenarios drafted by external consultants. Respondent Two did not gather criteria for market acceptance from his business environment and focused instead on achieving functional acceptance. Respondent Two and his teams also failed to execute experiments to prove market acceptance, and the company went ahead with the launch of the innovation without proof of market acceptance. The ultimate commercial failure and competitive threat posed by this innovation to their 'business-to-business' customer (customer A) led to the closing down of the research and development structure, which demonstrates that Respondent Two was unable to maintain a positive relationship between ongoing operations and innovation initiatives. The failures experienced in Case Study Two may not all be attributed to the innovation leader himself, but the failure of the organisation to apply the underlying principles and process of innovation in a similar manner to the six successful case studies demonstrated the importance of reasonable achievement of all principles in order to provide a reasonable chance of success for innovation initiatives.

5.8.1 Summary of Research Question Nine:

How do the innovation leaders maintain a positive working relationship between ongoing operations and innovation initiatives?

...and theoretical proposition Nine:

The principles underpinning the activities of innovation leaders – technology, market requirements, resource networks, integration of internal and external learning through experimentation, organisational structure, planning and the selection and management of the innovation team in the local social context – provide a compelling business case for innovation initiatives, enabling innovation leaders to manage open and constructive relationships between ongoing operations and the innovation initiative.

...which confirm that successful South African innovation leaders used the principle of maintaining a positive relationship between ongoing operations and innovation initiatives, as demonstrated by research undertaken in First World economies by Govindarajan and Trimble (2010).

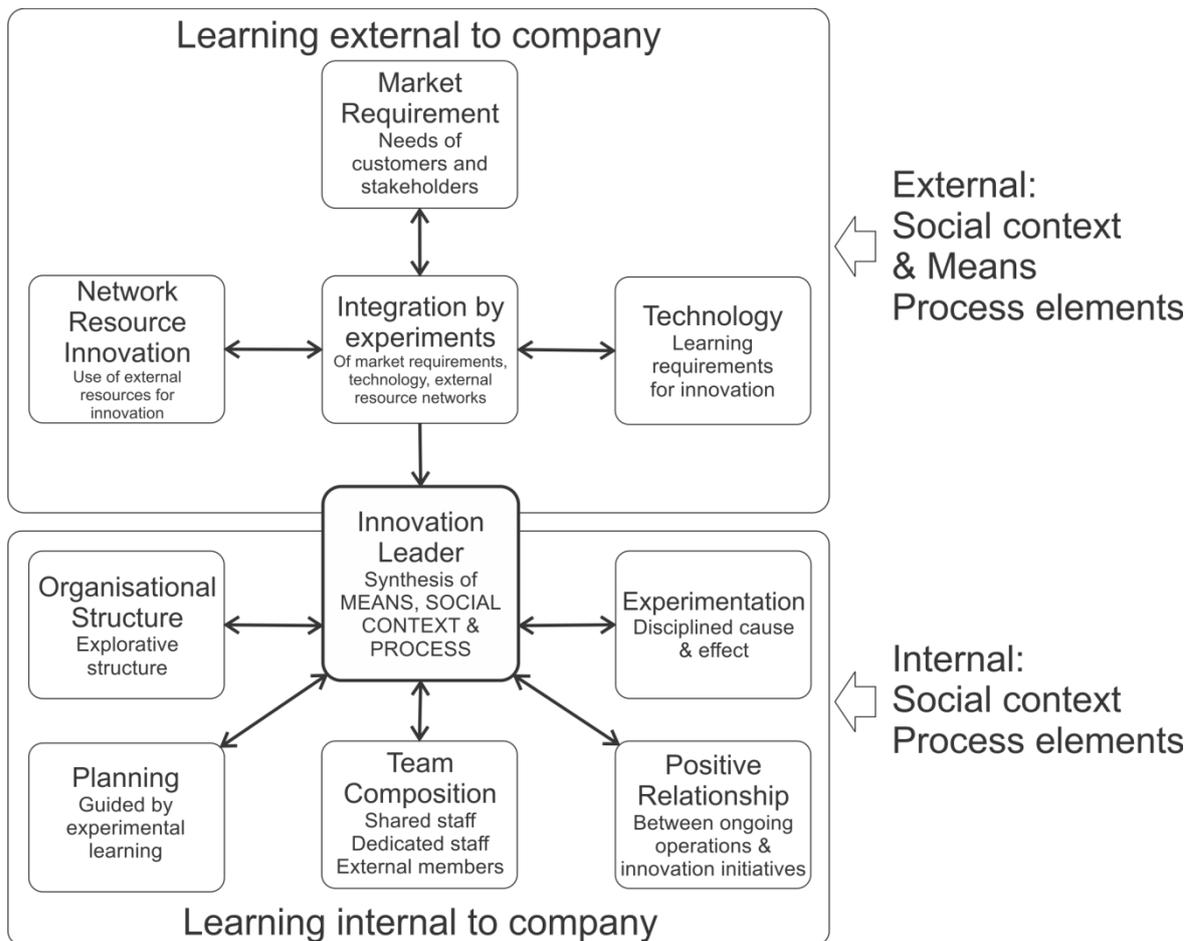
In answering Research Sub-Purpose Nine:

To determine whether the positive working relationship between ongoing operations and innovation initiatives is maintained by innovation leaders who practised the principles of the conceptual framework in their social context, thereby confirming or disputing whether the innovation leaders' effective execution of the underpinning principles of the conceptual framework gains support from the ongoing operations of South African companies, and determining the contribution of the positive working relationship to the model for innovation leadership in South African companies.

The data gathered from the seven cases demonstrated that the principle of maintaining a positive relationship between ongoing operations and innovation initiatives allowed innovation leaders and their teams to explore and extract value from new ideas thereby confirming this principle applies in South African economic context and is not only suitable for First World economic contexts.

5.9 Summary of data interpretation

The conceptual framework resulting from the literature review was used to question the innovation leaders at the seven companies participating in this case study in order to determine how the *means* and *social context* attributes contributed to their successful innovation projects. The conceptual framework grouped learning for innovation into internal and external learning groups, with the innovation leader/s as the agent through which these two groups of learning were integrated, as shown in Figure 25 (repeated below).



Repeat of Figure 25: Innovation leader conceptual framework

The results of the data presentation and analysis in Chapter 4 and the discussion and interpretation of data in Chapter 5 confirmed that the innovation leader played a central role in successfully synthesising internal and external learning for innovation projects. The in-depth questioning of the innovation leaders confirmed that the external *means* and the external and internal *social context* elements presented in the conceptual framework all contributed to the blend of internal and external learning for successful innovation

projects. After the analysis and interpretation of data in Chapters 4 and 5, the conceptual framework was presented to the innovation leaders of the cases for discussion and validation. Four case studies participated in the validation (Case Studies Four, Five, Six and Seven).

Validation of the conceptual framework with case study innovation leaders yielded the following recommendations:	Case Four	Case Five	Case Six	Case Seven
1. Innovation leaders are central to the synthesis of principles	Yes	Yes	Yes	Yes
2. Agree to the inclusion of the market requirements principle in the model	Yes	Yes	Yes	Yes
3. Agree to the inclusion of the technology principle in the model	Yes	Yes	Yes	Yes
4. Agree to the inclusion of the external resource network principle in the model	Yes	Yes	Yes	Yes
5. Agree to the inclusion of the experimentation principle in the model with iterative process illustrated	Yes	Yes	Yes	Yes
6. Agree to the inclusion of the explorative organisational principle in the model	Yes	Yes	Yes	Yes
7. Agree to the inclusion of the planning through learning principle in the model	Yes	Yes	Yes	Yes
8. Agree to the inclusion of the team composition principle in the model	Yes	Yes	Yes	Yes
9. Agree to the inclusion of the positive relationship principle in the model	Yes	Yes	Yes	Yes

Table 28: Participant validation of principles

All the cases confirmed that the innovation leader/s played a central role in synthesising all the principles presented in the conceptual framework (Table 27). The principle of market requirements, which focuses on the needs of the customer and the external market conditions, was specifically highlighted by the respondents in Case Studies Five, Six and Seven as an essential focus of their successful innovation projects. The principle of market requirements was their main focus, with both technology and resource networks playing a supporting role. In Case Study Six, for example, Respondent Six commented that understanding the market requirements of their current and potential customers was central to their innovation efforts. The respondents of all the case studies confirmed that they used the principle of Technology to support the development of successful innovation projects and confirmed that it should be included in the model. The respondents of all the case studies confirmed that they used external resource networks to support the development of their successful innovation projects and that this principle should be included in the model.

The principle of experimentation, which spanned the boundary between external and internal learning, was confirmed by the respondents of all the case studies to represent the essential bulk of the effort they expended on successful innovation projects. The

Respondent in Case Study Five, for example, described how the iterative experimental process over time had developed their simple cellular phone transaction service into a robust service used by a significant portion of their customers. Respondents commented that a graphic representation demonstrating the cyclical nature of the Experimentation principle would better represent the actual processes they followed. The respondents commented that a single box spanning internal and external learning, as opposed to the two boxes presented in the conceptual framework, would be less confusing. The single box should include key words of the cyclical experimental process in the model.

All the respondents confirmed that they used the internal principles of explorative organisational structure, planning guided by learning and innovation project teams comprising shared and dedicated staff to manage successful innovation projects and that these should be included in the model. The principle of maintaining a positive relationship between ongoing operations and innovation projects was highlighted by Respondents Five and Six as an essential part of their efforts to gain internal acceptance “buy in” from their own companies. All the respondents confirmed that they maintained positive relationships between ongoing operations and their successful innovation projects and that this should be included in the model.

The model of innovation leadership in South African companies is informed by the conceptual framework and confirmed by the interpretation of the data and the validation of the conceptual framework elements presented to the respondents after the initial data collection and analysis. Based on this process, the model is presented in Figure 30 below.

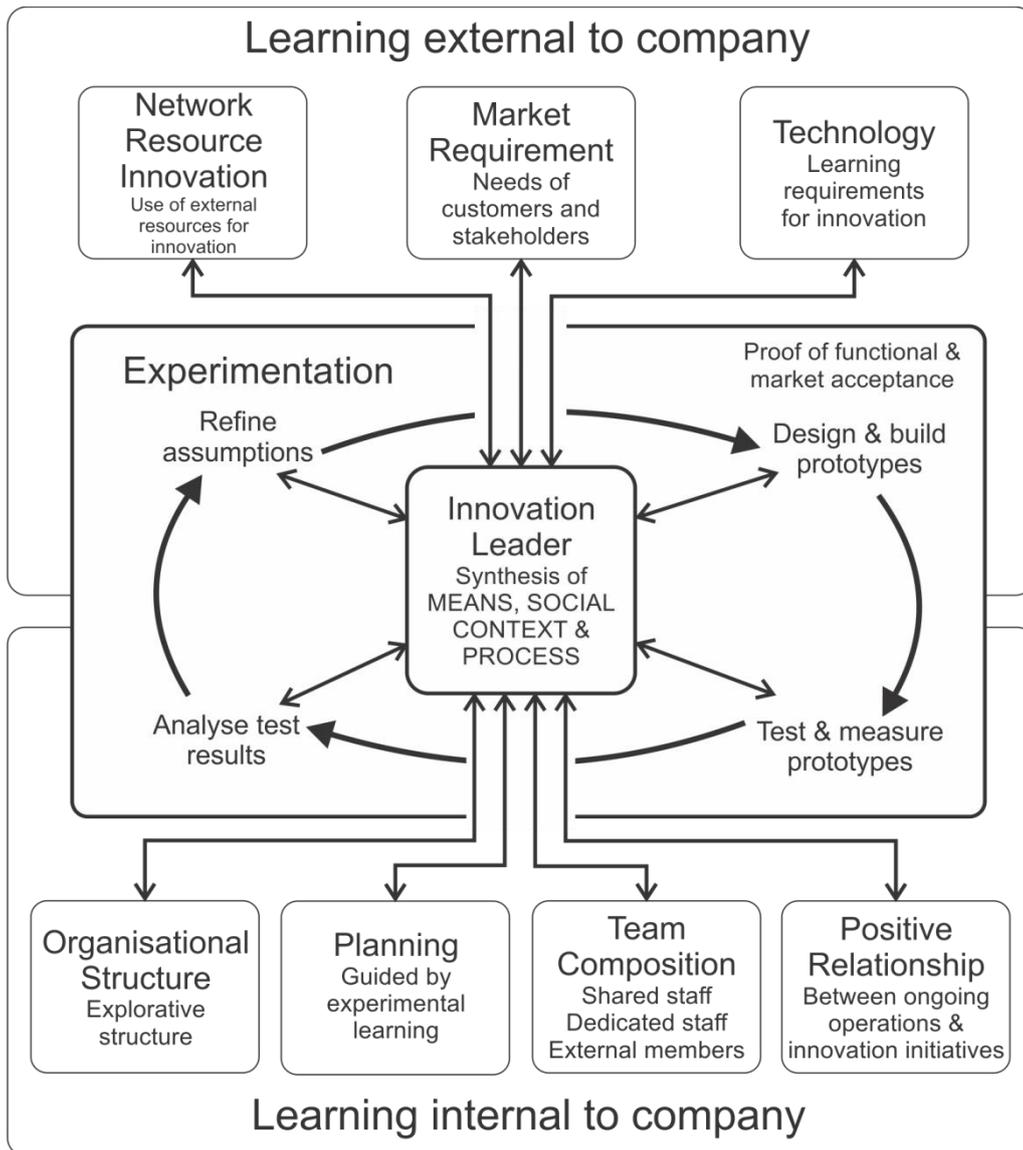


Figure 30: Model for Innovation Leadership in South African companies

In summary, the model retains the internal and external learning groupings and the four internal principles of organisational structure, planning, team composition and positive relationship. Three of the external *means* principles, namely technology, market requirements and external resource networks, are retained. The two parts of the experimentation principle (internal and external) are combined into one, spanning the boundary between internal and external learning. All principles interact with the innovation leader/s placed at the centre of the model, demonstrating how competent synthesis of these principles has resulted in successful innovation projects in the South African *social context*. Chapter 6 presents the conclusions drawn from this study.

Chapter 6: Conclusions

This chapter consists of three sections, namely the conclusions, the summary of contributions and recommendations for further research.

6.1 Conclusions

At the outset of this study, the *thesis statement* took the following position:

The underpinning principles and processes applied by innovation leaders who successfully commercialise innovation initiatives in South African companies are not fully described by the First World model of internal innovation execution, since these principles and processes fail to account for the combination of *social context*, *means* and internal and external *learning* practised by South African innovation leaders.

The results supported this thesis statement and were presented as a new model that described the context-specific combination of internal and external processes used by South African innovation leaders in successful innovation projects. The Innovation Leadership Model for South African companies has adapted the established First World model to more accurately reflect the processes that South African innovation leaders used to successfully commercialise innovation initiatives.

Research Finding One: South African innovation leaders used the *means* of technology within their internal and external *social context* to develop innovative solutions. The data showed in all cases that innovation leaders used a synthesis of existing technologies to develop innovative products and services. None of the cases undertook fundamental research to create new technology that could be applied to innovative products and services.

Research Finding Two: South African innovation leaders used the *means* of market requirements within their internal and external *social context* to develop innovative solutions. The data showed in five cases that innovation leaders used a proactive learning method to develop innovative products and services that differentiated them from their competitors. In one case the innovation leader used a reactive learning method to develop innovative products, allowing them to keep abreast and compete with their competitors. In the negative case, no market requirement learning was undertaken by the innovation leader, and the innovative product and service offering failed commercially as

customers and the marketplace complained that the solution did not offer what they required.

Research Finding Three: South African innovation leaders used the *means* of external resource networks within their internal and external *social context* to develop innovative solutions. The data showed in all cases that innovation leaders used the “outside-in” method to develop innovative products and services. The “outside-in” method implies that learning from external resource networks was brought into the company’s innovation process to help develop the innovative solution, giving the company control of the intellectual property and exploitation of innovative products and services. None of the cases used the “inside-out” method in which control of the intellectual property and innovation outputs are shared with external partners.

Research Finding Four: South African innovation leaders used the process of experimentation within their internal and external *social context* to develop innovative solutions. The data showed in all cases that innovation leaders’ experimental process spanned the boundary between internal and external learning. Using disciplined cause-and-effect experiments, innovation leaders were able to prove functional and market acceptance for their innovative solutions in all six successful cases.

Research Finding Five: South African innovation leaders used explorative organisational structures to develop innovative solutions from within their internal *social context*. This confirmed the use of exploratory organisational structures by South African innovation leaders, as observed in First World economies.

Research Finding Six: South African innovation leaders used planning methods informed by organisational learning to develop innovative solutions from within their *social context*. This confirmed the use of planning based on learning by South African innovation leaders, as observed in First World economies.

Research Finding Seven: South African innovation leaders selected and managed innovation teams that consisted of shared and dedicated internal staff members, and in some cases external members were also included in these teams to develop innovative solutions from within their *social context*. This confirmed the use of innovation team members from a blend of different company departments by South African innovation leaders, as observed in First World economies.

Research Finding Eight: South African innovation leaders actively maintained a positive working relationship between ongoing operations and innovation initiatives from within

their *social context* by effectively executing the principles and experimental process described in the South African Innovation Leadership model. This confirmed the maintenance of a positive relationship between ongoing operations and innovation projects by South African innovation leaders, as observed in First World economies.

The main research question posed for this study was:

How do successful innovation leaders in existing South African companies use the *means* at their disposal to *learn* from within their company's *social context* to execute successful innovation projects?

The research found that successful innovation leaders at existing South African companies practised innovation leadership by synthesising existing technologies to meet specific market requirements that they had determined, which allowed these companies to compete or differentiate themselves from their competitors. These innovation leaders used external resource networks and their company's capabilities to learn through a process of disciplined experimentation what constituted functional and market acceptance for the new innovative products and services. The experimental learning for functional and market acceptance was supported by their company's explorative organisational structure, planning process that lead to new learning, the innovation project team consisting of a mix of dedicated and shared staff members, and their ability to maintain a positive relationship between ongoing operations and innovation projects within the company.

This study attempted to address the following problem:

Ideally, the underpinning principles and processes that innovation leaders practise in South African companies are well-established. In reality, however, the extent to which these principles and processes are known and adapted to the South African *means* and *social context* was found to be limited. Without this locally developed understanding, the processes and underpinning principles for leading innovation remains a "black box", perpetuating innovation leaders' struggle to advocate and execute innovation initiatives.

The problem has been addressed by identifying underpinning principles and processes that successful South African innovation leaders have practised and presenting these in a model intended to guide the future practice of innovation leadership in South Africa. The literature review found that limited understanding of innovation leadership practice in South Africa existed (Urban and Wood 2017) and (Grobler and Singh 2018). A recent

study by Urban and Wood (2017) found that South African corporate entrepreneurs who are supported by their companies and are alert to market opportunities use their metacognitive abilities to drive innovation initiatives forward. This research builds on the work of Urban and Wood (2017) by providing a more in-depth understanding of how innovation leaders, a sub-set of the corporate entrepreneur grouping, used the *means* and *social context* attributes of innovation to practise successful innovation. The outcome of this research is introductory in nature, presenting a model of innovation leadership practice in the South African context where no model was found to exist before.

6.2 Summary of contributions

In this section, the theoretical and practical contributions are discussed, followed by their implications. The conceptual framework used a selection of principles extracted from the literature to question South African innovation leaders about commercially successful products and services they helped develop. This questioning strategy was used to expose how each innovation leader successfully combined internal and external processes in order to commercialise innovations from within their specific *social context*.

6.2.1 Contribution to knowledge

In the South African business context, it is understood that innovation driven by corporate entrepreneurship (individual staff members) requires a supportive relationship with the business organisation (Urban and Wood 2017). The corporate building blocks of the organisation, namely management support, structural support, rewards, organisational boundaries (risk) and resources, have an influential relationship with individual staff members' entrepreneurial alertness and metacognition (Urban and Wood 2017). These findings by Urban and Wood (2017) have been proved valid for all staff members (innovation team members and their leaders) involved in corporate entrepreneurship for innovation. This research contributes to this established theory by focusing only on the practice of leaders of innovation projects who are part of the corporate entrepreneurship effort of the company. Specifically studying the practice of South African innovation leaders contributes to the theory by describing some of the underpinning principles and processes they used in the execution of successful innovation projects. This research project contributed to the theory by responding to the call to investigate the interaction of contextual, cognitive and behavioural concepts for corporate entrepreneurship in South African companies, and in particular the interaction of the innovation leaders' contextual, cognitive and behavioural role for innovation projects.

Innovation leaders' *social context*: This research investigated the innovation leaders' interaction with some of the *social context* concepts divided into internal and external

social contexts. The chosen internal *social context* concepts were organisational structure, planning and innovation project team composition. The chosen external *social context* concepts were technology, market requirements and resource networks.

Innovation leaders' cognition: This research investigated the innovation leaders' cognition by gaining a deeper understanding of how he/she used the process of experimentation in a disciplined manner to obtain functional and market acceptance for new innovations.

Innovation leaders' behaviour: This research investigated the innovation leaders' behaviour by gaining a deeper understanding of the behaviours he/she used to maintain a positive working relationship between ongoing operations and innovation projects.

The outcome of this research presented the culmination of these concepts in a model of practice describing underpinning principles and processes used by successful South African innovation leaders.

Theoretical Contribution One: The in-depth investigation of the innovation leaders' interaction with selected internal *social contexts* (organisational structure, planning and innovation project team composition) and external social constructs (technology, market requirements and resource networks) has contributed to this theory by identifying and confirming that South African innovation leaders made use of these internal and external social constructs to develop successful innovative products and services, as this has not been previously reported in theory.

Theoretical Contribution Two: The in-depth investigation of the innovation leaders' cognitive abilities has contributed to this theory by identifying and explaining that South African innovation leaders used a process of disciplined cause-and-effect experimentation to prove the functional and market acceptance for new innovative solutions as part of the innovation process prior to commercial exploitation as this has not been previously reported in theory.

Theoretical Contribution Three: The in-depth investigation of the innovation leaders' behaviour contributed to this theory by identifying and confirming that South African innovation leaders actively maintained a positive relationship between ongoing operations and innovation projects by applying the underpinning principles and processes of the model, ensuring that innovation projects were afforded the necessary internal resources and support required to develop these initiatives to successful commercial exploitation, as this has not been reported in theory.

In the acknowledged absence of scientifically proven theory on how South African innovation leaders integrate their *social contexts*, cognitive abilities and behaviour, these findings provide an introductory understanding and theory upon which more detailed and sophisticated research may be undertaken to improve the understanding of the innovation leadership phenomenon.

Practical Contribution One: Presenting a model of practice for South African innovation leaders has a potential contribution to the practice of innovation leadership in South African companies, as a model explaining the practice of innovation leaders has not been previously reported in theory. Using real-world case studies and their role model innovation leaders as the basis for the model might enhance the training and practice of other South African companies, as called for by Urban and Wood (2017). Urban and Wood (2017) point out that the rapid pace at which technology and knowledge become obsolete is cause for concern, and that models of practice such as the one presented by this research might help enhance levels of entrepreneurial alertness and metacognition to take advantage of short-lived entrepreneurial opportunities for innovation and commercial exploitation.

6.2.2 Implications of contributions

This section describes the theoretical and practical implications of this study.

Theoretical Implication One: The innovation leaders' interaction with internal and external *social contexts* plays an important role in achieving alignment between the capabilities of the company, their external context and the entrepreneurial opportunities identified by the company for exploitation, as identified by Rothwell (1994) and Chesbrough (2010, 2012).

Theoretical Implication Two: The innovation leaders' cognitive ability to use disciplined experimentation helps to ensure that the effort and resources invested by the company into innovation projects produce outcomes that function appropriately and meet the needs of their consumers, thereby managing the risk required to invest in innovation projects by producing evidence during the development process, as called for by Martin (2007).

Theoretical Implication Three: The innovation leaders' behaviour of maintaining a positive working relationship between ongoing operations and innovation projects provides innovation leaders with the ability to positively influence opinion leaders at various levels within the company. This essential "buy in" from within the company provides access to company resources and tacit knowledge, which significantly improves the quality and likelihood of success for innovative outputs, and promotes shared

ownership of innovations within the company, as identified by Govindarajan and Trimble (2010).

The practical implications of the model are intended to guide and enhance the practice of less-experienced innovation leaders in existing companies. The model might benefit the practice of innovation leadership among theoreticians who study innovation leadership, practising innovation leaders and their business organisations, educators involved in training innovation leadership skills, and local policymakers who contribute to the development and implementation of local innovation policy.

Practical Implication One: Theoreticians could benefit from the new case studies, as no data have been collected about this topic using this method in South Africa before. The new data build on existing research on the execution of innovation by investigating how underpinning principles and processes guide innovation leaders in the context of emerging economies, providing theoreticians with new insights for further inquiry and validation to deepen the understanding of the principles and processes used for innovation leadership.

Practical Implication Two: Practising innovation leaders in operational businesses could benefit from this research by using the model to visualise and explain to company management the common principles and the actions required for successful innovation. The model could also help innovation leaders improve their practice of innovation and build a robust innovation process within the company.

Practical Implication Three: Educators could benefit from this research by using this new understanding of the common principles for innovation leadership, and applying the model to develop and deliver training curricula for innovation leadership skills development.

Practical Implication Four: Policymakers could benefit from this research by using this new understanding of these principles and processes for innovation leadership and making an impact at the micro level, which is acknowledged by Lorentzen (2009) and Blankley and Booyens (2010) to be missing from local innovation policy, particularly on the commercialisation of know-how in companies.

6.3 Recommendations for further research

Three recommendations are made for future studies:

- **The generalisability of the new model:** The generalisability of this work is limited by the research method, which instead of focusing on generalisability focused on an in-

depth understanding how innovation leaders execute innovation in existing South African companies. A suggested topic for future research would be to undertake a quantitative study of the model used by innovation leaders. Analysing the principles and processes with a representative sample of the innovation leadership population in South African companies might determine whether or not the principles are generalisable to the South African population of innovation leaders.

- **Determining the value of the model:** The model developed as a result of this study has only been validated by case study participants; therefore the value of the model has not been thoroughly determined. A future research direction might be to undertake a longitudinal study to investigate over time how selected innovation leaders have made use of the model to guide their execution of innovation projects. Observing the use of the model would help confirm or dispute its value as a tool for guiding the work of innovation leaders. Such observations might be able to strengthen or correct the model and improve its effectiveness.
- **Understanding the relationship between the principles:** The way in which the principles and processes relate to and affect one another is not well understood. Investigating in more detail how the principles and processes and their immediate and intermediate outcomes interact and affect one another might help innovation leaders sequence and appropriately balance the effort expended on each principle and process, contributing to greater efficiency in leading the innovation process.

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