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The relationship between innovation ability and business network utilisation in emerging economies

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A research project submitted to the Gordon Institute of Business Science, University of Pretoria, in partial fulfilment of the requirements for the degree of Master of Business Administration.

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ABSTRACT

It is well accepted in business practice that there are advantages for individuals and organisations in utilising their relationship networks for the purposes of personal and business advancement. Furthermore, the need for firms to develop the ability to innovate products, processes and positions to remain competitive is well-documented. The purpose of this research was to make an academic contribution to the body of knowledge of the relationship between networking and innovation in firms operating in emerging economies.

The research drew on the previous understanding of theories of business networks and innovation, and in some respects drew from relevant empirical studies from emerging economies. The literature review identified key concepts and business network descriptors to be used in the data analysis.

Secondary data (using survey methodology) from the European Union INGINEUS project [No 225368] was used for this analysis. Using 720 responses, the data was analysed to investigate possible associations between each set of business network descriptors and innovation. This analysis was then expanded to build a regression model, revealing empirical evidence of significant relationships between some of the sub-variables for *Country*, *Company structure*, *Collaboration type* and *Linkage type* with *Level of innovation*. From this, key recommendations could be inferred for policymakers, business managers and entrepreneurs.

Keywords: Innovation, business networks, emerging markets, Brazil, China, India, South Africa

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

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CONTENTS

CHAPTER 1: INTRODUCTION

1.1. The impact of business networks on innovation ability in emerging economies

The global market is made up of actors – states and organisations, whether these are local or global. The advent of globalisation and the Internet has made the interaction between these actors seamless and opened up a world of opportunities. The flipside however is that competition is far more fierce and cut-throat (Dilk, Gleich, Wald, & Motwani, 2008).

Organisations are increasingly looking to improve the way they manage both the efficiency and effectiveness of their various innovation activities. This creates the need for organisations to share information and resources in an efficient and cost effective manner, mostly through utilising business and personal networks.

One of the features of a successful organisation or a firm is to innovate to enter, grow or maintain dominance within an industry. The opportunity to harness this innovation ability is influenced, in a positive or negative way, by the firm's access to and utilisation of business networks. Harnessing this opportunity becomes even more important to firms operating in developing countries and regions. Markets in these contexts are often more fragmented and operations smaller. Therefore innovation needs to be more accurately targeted at the specific needs of consumers to continue to capture market share and increase profit. This research consequently attempts to describe how institutions in developing countries (Brazil, China, India and South Africa) make use of their business networks to foster innovation.

1.2. Introduction to the research problem: innovation, business networks and growing markets

1.2.1. Innovation

Innovation is the engine that drives growth and constant change across industries. During times of disruptive economic conditions, "…innovation is both a vaccine against market slowdowns and an elixir that rejuvenates growth…" (Rigby, Gruver, & Allen, 2009). Innovation therefore becomes a critical element of organisational strategy for any organisation that seeks to achieve and sustain success over time.

The ability to innovate is particularly important in environments where competition is stronger and more diversified. However, small firms often lack the resources to innovate. Day (2007) found that minor innovations (so-called "little i" innovations) on average make up 85% to 90% of companies' development portfolios; however rarely generate the growth companies seek, provide a competitive edge or contribute much to profitability.

This leads to the need for firms to acquire the ability to innovate externally, either through inter-organisational relationships or networking (Dickson & Hadjimanolis, 1998; Xu, Lin, & Lin, 2008). Innovation that is new to the company or new to the world (the so-called "Big I" innovations) are more likely to push the firm into adjacent markets or novel technologies and can generate the profits required to close the gap between revenue forecasts and growth goals (Day, 2007). However, this type of innovation is also perceived to carry more risk.

1.2.2. Using business networks for innovation

Networking relationships allow small organisations to overcome some of the resource barriers to innovation. The inter-relationship and dynamics in a network of actors leads to innovation as a product (Arias, 1995). According to Mu et al. (2008), “weak ties help firms build initial relationships and strong ties help firms to acquire higher-quality and fine-grained knowledge”.

The power of business networks is not in their size; rather it lies in having more ties to network nodes who themselves are not connected (Cross, 2011). Access to less-connected ties means more access to ideas that have not been exposed elsewhere, and being able to piece together the opportunities, new ideas and perspectives that can come from connections into different networks.

Strategic choices, such as whether to extend collaboration networks to customers and suppliers, will become increasingly important. With advances in Web 2.0 and social networking, the boundaries of organisations are stretched, allowing non-employees to offer their expertise in novel ways, like “crowd-sourcing”. According to Bughin, Chui, and Manyika (2010), many companies are now pushing substantially beyond that starting point, building and managing flexible networks that extend across internal and often external borders. The recession underscored the value of these porous, networked organisations (Bughin et al., 2010) and the flexible access to innovation they offer n managing volatility (Rigby et al., 2009).

1.2.3. The importance of Innovation and business networks in emerging markets

A distinguishing feature of economic organisations in emerging markets is the importance of networks and informal contractual arrangements (Khwaja, Mian, & Qamar, 2007). Not only are these networks robust and prevalent, but they generate large and real value for member firms, facilitating information sharing, trade, and contractual enforcement in weak institutional environments. In support of this perspective; Owolabi and Pal (2011) found that business networking plays a significant role in the probability of securing external corporate financing from both domestic private and foreign banks in Central and Eastern European countries.

Networking, specifically gaining access to innovative business networks, is also a critical vehicle for industrial development in developing countries. Anecdotal evidence has suggested that emerging economies, especially in the Southern hemisphere, are increasingly becoming a source for knowledge generation and the inception of ideas, forming a so-called new “technological frontier” for the development of knowledge (Barnard & Ismail, 2010).

Network types might be closely related to a country’s culture and norms. Shaughnessy and Vitalari (2011) conducted research into interest in innovation and how it changes across cultures, in the hope of measuring “innovation culture” in its purest form. They found that companies in India, Singapore and South Korea indicated a far broader base of innovation (including open innovation and new design) than their US, UK and Canadian counterparts (focusing more on R&D and patent development).

While the increased adoption of technology is a global phenomenon, the intensity of its usage is particularly impressive in emerging markets. Research has shown that disruptive business models arise when technology combines with extreme market conditions, such as customer demand for very low price points, poor infrastructure, hard-to-access suppliers, and low cost curves for talent (Bughin et al., 2010). As institutions built around the new models emerge as global players, developing markets are increasingly positioned as sources of technology-enabled innovation rather than as traditional manufacturing hubs.

1.3. Conceptual framework

The diagram in Figure **1.3** presents the conceptual framework developed to frame the research problem, guide the literature review and provide impetus for the analytical approach.

FIGURE 1.3

CONCEPTUAL FRAMEWORK

ORGANISATIONS FUNCTION AS INTERACTIVE SYSTEMS	Organisations function as systems of interdependent actors who collectively share some goals for creating and realising value through their interactions.  	
INTERACTIVE RELATIONSHIPS GIVE RISE TO NETWORK BEHAVIOUR	1. We know how networks work 2. Business networks in the field of strategic management is well-documented 3. Networks hold advantages for organisations: ▪ Competitive advantage ▪ Diffusion on innovation and ideas ▪ Improved quality of decision-making	Section **2.1.2** Section **2.1.3** Section **2.1.4**
***but* IN ORDER TO MAINTAIN THEIR COMPETITIVE ADVANTAGE, ORGANISATIONS NEED TO INNOVATE**	1. We know what innovation means in business 2. It is particularly important for SMME's – 3. Especially in emerging markets	Section **2.2.1** Section **2.3.2** Section **2.2.2**
***therefore we think that* ORGANISATIONS IN EMERGING MARKETS USE THEIR NETWORKS TO INNOVATE**	**RESEARCH TOPIC** ***The relationship between innovation ability and the use of business networks in emerging economies***	Section **2.3**
***and* WE ARE INTERESTED TO FIND OUT:**	In emerging markets: 1. What kind of networks are used for innovation? 2. How do organisations use networks in their own or other markets? 3. How does the source of input through their network contribute to innovation? 4. How does the use of formal or informal networks impact innovation? 5. How does the use of "strong ties" or "weak ties" impact innovation?	Section **3**

1.4. Rationale of the research

It is well accepted in business practice that there are advantages for individuals and organisations in utilising their relationship networks for the purposes of personal and business advancement. Furthermore, the need for firms to develop the ability to innovate products, processes and positions to remain competitive is well-documented.

The purpose of this research was to make an academic contribution to the body of the knowledge of the relationship between networking and innovation in firms operating in developing countries.

This knowledge hopes to assist policy makers, entrepreneurs, academics and other stakeholders associated with economic development in developing countries, to work on the challenges and beneficially utilise the opportunities that exist. This contribution furthermore hopes to assist organisational strategists to devise tactics to make optimal use of the network opportunities available to the firm to maximise the efficiency and effectiveness of innovation.

The research report begins by clarifying some of the key concepts investigated in this research. It reviews the theory from the existing available literature on business networks, including network elements, measures of span and depth, the various typologies that exist in network literature and the importance of networks in the business environment. It then considers available literature on innovation, focusing on the importance of innovation in dynamic markets. This section concludes in an overview of the literature that links the important impact of business networks on innovation. Next, the salient features form the literature review are analysed to determine the research questions. Following this, the

research methodology used for the study and the findings of the study are discussed. This is followed by a discussion of the findings, which will aimed to reach conclusions on:

- The type of networks that foster innovation, e.g. which actors are involved, are the networks local/ global;
- The types of innovation ability (product, process or position) that is enhanced through the effective utilisation of networks.

CHAPTER 2: LITERATURE REVIEW

2.1. Business networks

2.1.1. General terminology

After review of relevant literature, it was clear that a myriad of terms, depictions and synonyms are used by different researchers to describe similar concepts. In the interest of clarity and consistency, the following terminology will be used in this research project:

- When referring to and describing businesses and organisations, the term ***firm*** is used when referring to for-profit entities and the term ***organisation*** is used to refer to a wider group of business actors that are found in business networks, including institutions like universities.
- Some of the literature reviewed (please see section **2.1.3** for a discussion of the typology) in terms of networking refers to *social networks* to describe the relationships between organisations and individuals. Recent developments expanded this term to also include social media, and therefore the term could be misleading. This research project aimed to specifically look at the business relationship between firms and organisations and individuals, and for this purpose the term ***business network*** will be used, taking cognisance of and referring to source terminology where required.
- The research project aimed to comment on the nature of innovation ability and business networks in ***emerging economies***. While other terms for this concept exist, such as *dynamic markets*, emerging economies is preferred as an academic descriptor.

2.1.2. Network elements

Borgatti and Foster (2003, p. 992) defined a ***network*** as "…a set of actors connected by a set of ties". ***Actors*** are also referred to as ***nodes*** and can be persons, teams, organisations or other concepts. When the network of a single actor is studied, it is referred to as an ***ego-network*** (Borgatti & Foster, 2003). ***Ties*** connect actors, and different types can be identified (Borgatti & Foster, 2003):

- **Directed** – potentially one-directional, e.g. giving advice to someone; *OR*
- **Undirected** – being physically approximate;

AND

- **Dichotomous** – present (positive) or absent (negative) (based on Davis' (1967) analysis of *cluster-ability*); *OR*
- **Valued** – measured on a scale, in terms of strength.

The ***strength*** of a tie can be determined through "…a…combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterise a tie" (Granovetter, 1973, p. 1361). A tie can therefore be identified as present – whether strong or weak – or absent.

Granovetter (1973) argued that weak ties are important in analysing social networks as it provides access to unrelated networks for actors in an existing network. He described two important contentions in this regard, based on the principles of ***dyadic ties***:

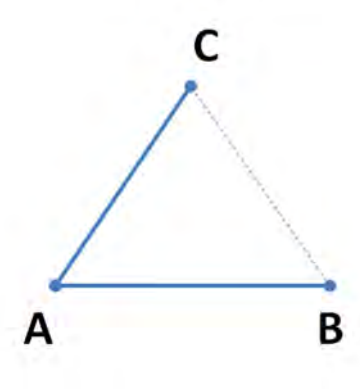


FIGURE 2.1.2a

- The stronger the tie between *A* and *B*, the larger the proportion of possible individuals to which they will both be tied. This will also indicate that *A* and *B* are likely to be very similar;
- The overlap in their relationship circles is predicted to be least when their tie is absent, most when it is strong and intermediate when it is weak;
- Drawing on the theory of cognitive balance, if strong ties *A* – *B* and *A* – *C* exist, and if *B* and *C* are aware of each other, there is a strong likelihood that a tie will also develop between *B* and *C*. The more time they spend together, the stronger this tie will become.
  - A weak tie may also serve as a ***bridge***, which is a line in a network that provides the only route among which information or influence can flow from any contact of A to any contact of B. If it is not the only route, it will still be the most likely and efficient path.
  - For some people in the network, the bridge may be the *only* path *between* networks.

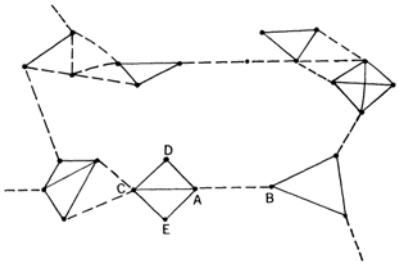


FIGURE 2.1.2b

i. Strong and weak ties – a measure of span

According to Granovetter (1973), only weak ties can serve as bridges, because they provide access to a different network through more, and shorter, paths. Strong ties give

access to similar networks and therefore act in an insular manner. A profusion of strong ties is said to form a ***dense*** network, whereas weak ties form a less dense one.

The implication for business is therefore that whatever needs to be diffused – be it information, innovation, products or services – can reach a larger number of people and span a greater social distance when passed through weak ties rather than strong. This means that individuals or organisations with many weak ties are best placed to diffuse innovation, since some of their weak ties will serve as bridges.

However, ***strong ties*** also have important roles to play in business relationships. Some of these are:

- To assist organisations to acquire higher-quality and fine-grained knowledge (Mu et al., 2008); and
- To provide support for new business ventures and help mitigate the risk associated with early adoption of innovation (McDonald & Westphal, 2008; McPherson, Smith-Lovin, & Cook, 2001), particularly through embedded ties (Borgatti & Foster, 2003).

ii. Formal and informal network ties – a measure of depth

Based on the nature of the network tie, networks can further be classified as ***formal*** or ***informal***. Not all organisations make use of formal networks, but all form part of a number of informal networks (Sulong, 2005). Informal networks are often used in the development, exchange and dissemination of knowledge (Allen, James, & Gamlen, 2007), while formal networks denote more permanent, contracted alliances (Stuart, 2000).

Formal linkages are considered especially strong, as they often provide the added benefit of legal protection (Li, Poppo, & Zhou, 2010). This is seen as an advantage especially in emerging markets. Over time individuals form and sever links connecting themselves to other individuals based on the improvement that the resulting network offers them relative to the current network. Such sequences of networks are referred to as “improving paths” (Jackson & Watts, 2002) and show that such sequences can include cycles, simultaneous improvements as well as evolutions.

However, even in formal linkages with mutually improving paths, trust may be reduced by formal control mechanisms (Malhotra & Murnighan, 2002), since interacting parties may attribute cooperation to the constraints imposed by the contract rather than to the individuals themselves. In this case, informal linkages may signal stronger relationships, based on loyalty and trust.

2.1.3. Typologies of network literature

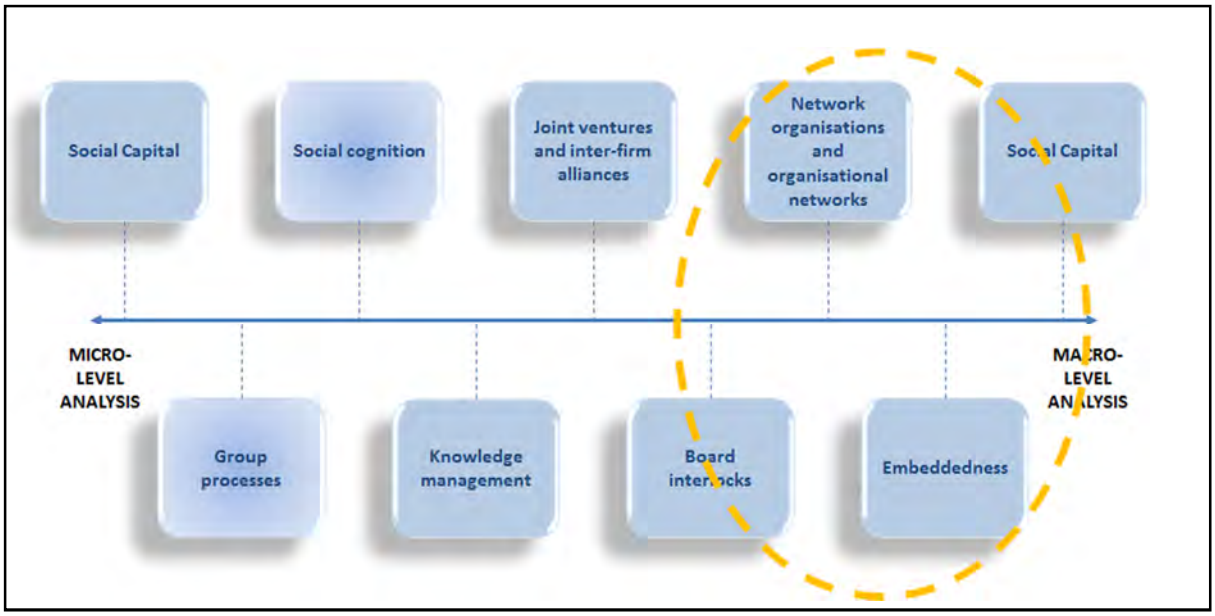
The analysis of social networks and the development of social network theory has its roots in social psychology, sociology, anthropology, mathematics and algebra. The implications for the field of strategic management became apparent through researchers demonstrating the extent to which informal networks influence work and life within and between organisations (Cross, Borgatti, & Parker, 2002) across the three main levels of analysis, being actor-, dyadic- and whole network level of analysis (Borgatti & Foster, 2003).

The growing body of social network literature has been noted (Pittaway et al., 2004; Borgatti & Foster, 2003; Van Laere & Heene, 2003; Cross et al., 2002). This is viewed by some as part of a general shift in research approaches, away from individualist,

essentialist and atomistic explanations toward more relational, contextual and systemic understandings (Borgatti & Foster, 2003).

A meta-analysis conducted by Borgatti and Foster (2003) yielded the eight (8) main categories of focus for research within the field of social network literature. These can be presented on a continuum, ordered from a macro- to a micro-level, as presented in the diagram below (**Figure 2.1.3**). In this framework, social capital is the exception as it is mostly studied at the individual level, but has macro implications.

FIGURE 2.1.3
CATEGORIES OF RESEARCH FOCUS AREAS IN SOCIAL NETWORK LITERATURE



(Freely adapted from Borgatti & Foster, 2003)

Within this framework, the category of ***embeddedness*** is of particular interest. This research area is the main focus of this particular study, as it tried to provide insight on the importance of networks for innovation, the creation of a competitive advantage and

ultimately the success of enterprises in emerging markets. Some overlap exists and the literature review includes elements of social capital and organisational networks (as indicated by the dotted circle in the diagram above).

Granovetter (1985) coined the term "embeddedness" in rejection of the neoclassical tradition of anonymous self-interested agents, which meant that economic behaviour is constrained by social relations. Unlike the traditional market based analysis where decentralised prices govern everything, an analysis embedded in networks pays a lot more attention to whom you are linked to, even if such relationships hold no legal or formal authority (Khwaja et al., 2007).

TABLE 2.1.3

CHARACTERISTICS OF TRADITIONAL AND NEW BUSINESS NETWORK APPROACHES

Characteristics	Traditional business network approach	New business network approach
Products and services	Relatively simple, unbundled, and slowly delivered products and services	Relatively complex, bundled, and fast delivered product and services
Value creation	Supply chains with long term connected relationships	Demand networks with quick connect and disconnect relationships
Coordination and control	Hierarchical and central control and decision-making	Network orchestration with distributed control and decision-making
Information sharing	Information sharing with direct business partners	Information sharing over and with network partners
Infrastructure	Actors platforms with information silos and systems	Network platform with networked business operating system

Source: Van Heck and Vervest, 2007

Based on the meta-analysis conducted by Borgatti and Foster (2003), embedded ties have been found to affect the choice of joint venture partners, the cost of capital, consumer purchasing decisions, the continuity of client relations, and the performance of firms with close ties both to competitors and suppliers. A central theme in this research category is that repeated interaction between actors and the linking of social and business relationships create an intrinsic approach to engagement that differs from that found in more traditional "arms-length" business relationships. The characteristics of the so-called "new business networks" as compared to the traditional approach of doing business is summarised in **Table 2.1.3**.

2.1.4. The importance of networks in the business environment

i. Networks provide a competitive advantage

The globalised market provides increased opportunities, but also challenges, to enterprises, especially in dynamic markets. Collaboration is viewed as increasingly central to organisational effectiveness (Van Laere & Heene, 2003), especially when smaller enterprises compete with their larger counterparts in regional or global markets.

Even though changes in global markets have led to fewer "elephants" (large conglomerates) and more "fleas" (small and medium enterprises) (Handy, 2001), smaller firms often lack contact with end-user markets (Van Laere & Heene, 2003). Increased competition can have a negative effect on innovation, especially for firms further from the technology frontier, with the supply chains of multinational enterprises and international trade remaining important channels for domestic firm innovation (Gorodnichenko, Svejnar,

& Terrell, 2008). This puts larger firms in a superior position both in terms of information and expertise. Smaller firms therefore need to collaborate with other actors in the environment and form strategic alliances to access knowledge and expertise to maintain their competitive advantage (Hamel, Doz, & Prahalad, 1989).

ii. Networks allow the diffusion of innovation and ideas

It is accepted knowledge in business practice that people use their network of relationships to find information and solve problems. According to Cross et al. (2002, p. 25), "…one of the most consistent findings in the social science literature is that who you know often has a great deal to do with what you come to know".

In trying to explain how this diffusion works, Granovetter (1973) used the concepts of *first adopters/ innovators* and *early adopters*. First adopters of new ideas or innovation are usually risk-takers, but tend to exist as marginal nodes in social networks. The next level of adoption happens through early adopters. While early adopters are not as immune to risk as the first adopters, they tend to present more integrated nodes in their local network system. Based on the principles of social networks as explained in section **2.1.2**, early adopters are likely the actors with more weak ties between networks, and therefore best placed to diffuse innovation, as some of their ties act as bridges.

iii. Networks improve the quality of decision-making

It is established that CEO's and enterprises have relationships with other executives and enterprises. McDonald, Khanna & Westphal (2008) pointed out that when seeking advice

and engaging in discussion on business topics, these relationships can take on two (2) forms:

- Seeking advice from friends who agree with them and/ or other executives with a similar background. In social networking literature, this is referred to as “strong ties” (McDonald & Westphal, 2008, McPherson et al., 2001); or
- Deliberately seeking exposure to alternate points of view from “non-friends or dissimilar others”. In social networking literature, this is referred to as “weak ties” (Burt, 2000, 2004; Granovetter, 1973).

Executives need to make a trade-off between the two approaches. While strong ties often lead to a subjective “sense of certainty” about perspectives and issues, and therefore a form of psychic affirmation, engaging through weak ties enhance the objective quality of strategic choices (McDonald et al., 2008). The latter option allows executives to develop high quality, innovative solutions that lead to increased organisational performance.

2.2. Innovation

2.2.1. Describing innovation in the business environment

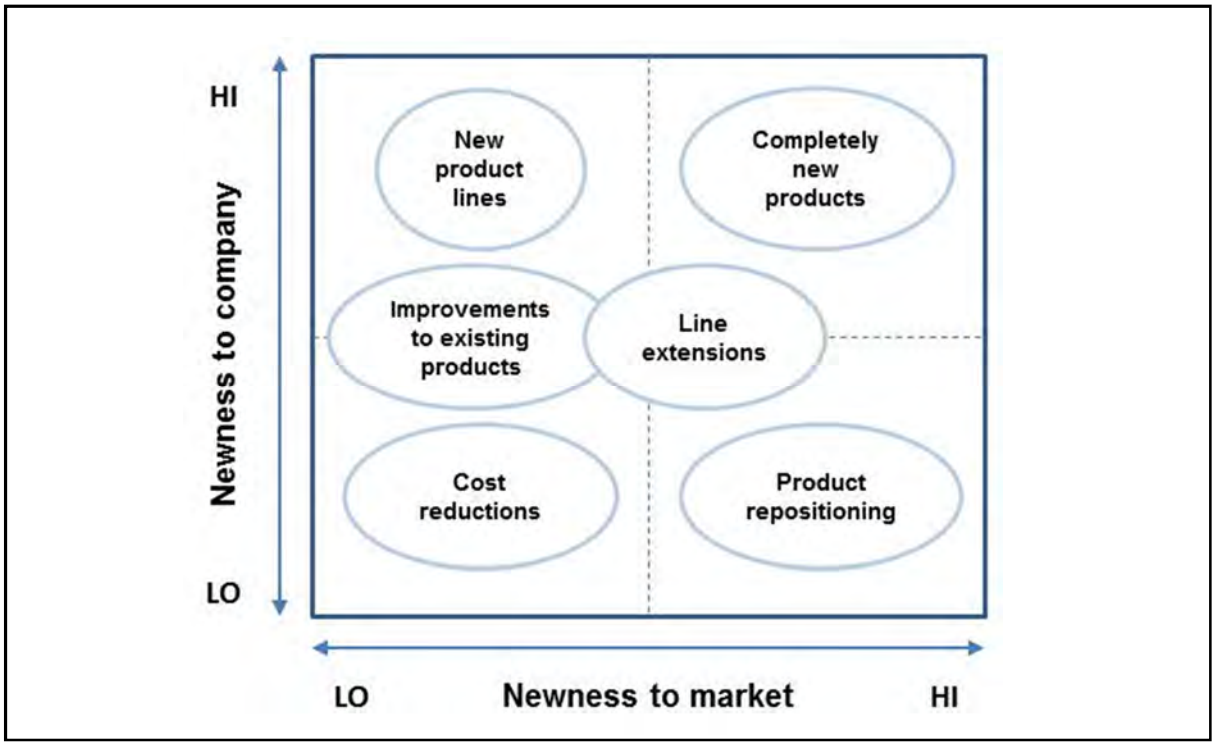
The following operational definition of innovation by Baregheh, Rowley, and Sambrook (2009, p.1334) is proposed for use in this research project:

“Innovation is the multistage process whereby organisations transform ideas into new or improved products, services or processes, in order to advance, compete and differentiate themselves successfully in the marketplace”.

Added to this is the dimension of continued innovation in strategic positioning in an effort to retain competitive advantage, as described by Hamel and Prahalad (1989).

FIGURE 2.2.1

DEGREES OF INNOVATION



(Source: Cooper, 2001)

According to Smith (2010), innovation had a number of dimensions:

- A technological and creative dimension, usually referred to as invention (Betje, 1998; Rogers, 1995); and
- A commercial dimension, that involves the exploitation of the invention to turn it into something that is available in the market for consumers to purchase (Freeman & Soete, 1997).

Innovation theory is interested in two particular aspects of innovation and "newness" – new to market and new to a company. This is presented in Figure **2.2.1** above. A growing heterogeneity of sources affecting the process of innovation (Garcia & Molero, 2005) and innovation outcomes (Rui, 2006) is noted. This points to the need for firms to build capacity in integrating internal and external sources of technological capacity with other competitive forces.

2.2.2. The importance of innovation in dynamic markets

Globalisation brings opportunities and pressures for domestic firms in emerging market economies to innovate and improve their competitive position. A study conducted by Gorodnichenko, Svejnar and Terrell (2008) showed the effects of globalisation through the impact of increased competition and foreign direct investment on domestic firms' efforts to raise their capability (innovate) by upgrading their technology, product or service (improving quality or developing a new one). The long-term competitiveness of firms from countries in emerging markets often depends on their ability to adapt through the development of new capabilities (Moran & Goshal, 1999).

The term ***innovation infrastructure*** can be used to describe the set of resources—such as finances, talent, and technologies—to which firms need access in order to undertake innovative activities (Mahmood & Mitchell, 2004). In developed economies, market-based transactions provide access to the most needed elements of innovation infrastructure. By contrast, many of these institutions only exist in relatively weak forms in emerging or dynamic markets. This highlights the importance of networks in contributing to innovation by substituting for functions that stand-alone institutions provide in developed economies.

2.3. Business networks and innovation

2.3.1. High-level overview of existing research

A number of academic articles have been published about the relationship between innovation and networking (Dil et al., 2008; Xu et al., 2008; Pittaway et al., 2004; Dickson & Hadjimanolis, 1998; Arias, 1995). The concept of groups of small firms interacting within an organised networked for innovative purposes have also been researched (Biemens, 1992; Nohria & Eccles, 1992).

A literature review conducted by Pittaway, Robertson, Munir and Denyer (2004) found that networking and innovation have been studied in a number of fields within social science and published in some key management journals. Further analysis revealed that these articles focused on the following two main themes:

- Firm-level (micro) factors exploring how networks are managed and work in practice (57.7% of articles reviewed); and
- Macro- or networking infrastructure that can support network activity (42.3% of articles reviewed).

2.3.2. How networks help foster innovation

According to Dickson and Hadjimanolis (1998), the increasing trend of strategic business collaborations was an important resource to overcome barriers to innovation. Networks provide access to externally controlled resources, especially highly specialised resources not readily available in the market.

This is particularly important to SMME's as their innovation activities may often extend beyond the boundaries of a single firm or market as they require resources and information (Van Laere & Heene, 2003). Small firms particularly benefit from alliances with large and innovative strategic partners, where alliances are both pathways for the exchange of resources and a form of endorsement that signals social status and recognition (Stuart, 2000).

Dilk et al. (2008) found that the goals companies aim to realise through innovation networks include flexible access to technologies, intensified contact with clients and markets and long-term bonding of suppliers, distributors and clients. In developed economies, these kinds of vertical intermediaries are often well established and firms can make use of existing linkages to access skills, equipment, and customers (Afuah 2000). In emerging or dynamic economies, these economic support sectors are often much weaker. Rather than rely on complementary external firms, business groups and networks often provide internal intermediation of such vertical business activities (Khanna & Palepu, 1997, Khanna & Rivkin, 2001). The internal vertical intermediation then provides innovation infrastructure.

Organisations should however not only look to collaboration in domestic markets. Business groups and networks can use relationships with foreign firms to gain the knowledge needed to develop and commercialise new ideas (Mahmood & Mitchell, 2004). These include research joint ventures, co-production, and co-marketing agreements. Furthermore, it is important for firms in emerging markets to create technological linkages with firms in advanced economies.

However, social networks in dynamic markets may have dual effects on innovation (Mahmood & Mitchell, 2004). While networks in the form of business groups facilitate innovation by providing institutional infrastructure, they also discourage innovation by creating entry barriers for non-group firms and thereby inhibit the proliferation of new ideas. This pattern reflects an evolutionary process in which the interplay of the availability of innovation infrastructure and variety of ideas influences the level of innovation in an industry.

2.3.3. Rationale behind the three major research questions

RESEARCH QUESTION 1

Are firms in emerging markets (Brazil, China, India and South Africa) that use internal sources of technology development more likely to have high levels of innovation than firms that use other sources of technology development (other firms or public sector organisations)?

Zaheer and Bell (2005) found that a firm's innovative capabilities and its network structure enhance firm performance, while the innovativeness of its contacts does not do so directly.

In contrast to this, Dickson and Hadjimanolis (1998) maintained that strategic business collaborations was an important resource to overcome barriers to innovation. This is particularly important to SMME's as their innovation activities may often extend beyond the boundaries of a single firm or market as they require resources and information (Van Laere & Heene, 2003). Small firms particularly benefit from alliances with large and innovative strategic partners, where alliances are both pathways for the exchange of

resources and a form of endorsement that signals social status and recognition (Stuart, 2000).

Thus, Research Question 1 states that the innovation level of firms in emerging economies that buy external sources of technology (from other firms or public sector organisations) is higher than those that produce technological inputs internally.

RESEARCH QUESTION 2

Are firms in emerging markets that actively collaborate with local non-firm actors (consulting companies, government and research institutions) more likely to have high levels of innovation than firms that collaborate with local or global firm actors (clients, suppliers, competitors)?

In trying to determine which firms enter into alliances and which do not, Gulati (1999) found that the organisations and institutions outside of a firm's immediate value chain (such as consultants, banks, associations, universities and public agencies) should also be considered when assessing the impact of network resources on firm performance and capabilities, including innovation. This finding is supported by qualitative research in advanced and emerging economies pointing to firms often being dependent on such organisations and institutions to acquire new skills, practices, capital and services (McDermott & Corredoira, 2010).

Thus, Research Question 2 states that the innovation level of firms in emerging economies that actively collaborate with institutions outside their immediate value chain (consulting

companies, government and research institutions) is higher than those that collaborate with value chain partners (clients, suppliers, competitors).

However, firms do not derive this benefit from their association with international institutions, but rather through participating in local training institutions (McDermott & Corredoira, 2005) and partnering with local institutions that provide R&D facilities as well as information on international process and product standards (Zhao, Anand & Mitchell, 2005).

Therefore the sub-questions related to Research Question 2 state that the innovation level of firms in emerging economies that actively collaborate with local institutions outside their immediate value chain (consulting companies, government and research institutions) is higher than those that collaborate with local or global value chain partners (clients, suppliers, competitors).

RESEARCH QUESTION 3

Are firms in emerging markets that develop formal links with other firms and institutions (whether these be firm or non-firm actors) more likely to have high levels of innovation than firms that form informal links, or have no linkages at all?

Firms participate in various types of networks, with some types of relationships proving more valuable as sources of knowledge and innovation than others. Emerging market countries often have weak institutions and public resources, leading to many foreign investors requiring the formal institutionalisation of relationships (McDermott & Corredoira, 2010).

Therefore, Research Question 3 states that the innovation level of firms in emerging economies that develop formal links with other firms and institutions is higher than those that develop informal links, or have no linkages at all.

The next chapter presents a summary of the research questions in the form of proposed hypotheses based on the analysis and the context of the various characteristics of business networks and their impact on innovation discussed so far.

CHAPTER 3: RESEARCH HYPOTHESES

With the literature review pointing to the fact that the relationship between networking and innovation has been well-established, this research project aimed to investigate different aspects of the relationship between innovation and networking. Specifically, this study was interested in investigating the sources of innovation established through business networks in emerging markets.

The variable for innovation was operationalised and presented as a continuous variable as well as a categorical variable (at three levels: *****, **i** and **I**) drawing from a typology developed by Dickson and Hadjimanolis (1998) and measured through Question 6 in the questionnaire. In each case, the level of innovation was the dependent variable.

The focus of this research was to describe **how firms in emerging economies like Brazil, China, India and South Africa use their business networks to improve their innovation ability**. Three main hypotheses have been formulated with respect to this research question.

Hypothesis 1

$H1_A$: The innovation level of firms in emerging economies that buy external sources of technology (from other firms or public sector organisations) is higher than those that produce technological inputs internally.

Hypothesis 2

$H2_A$: The innovation level of firms in emerging economies that actively collaborate with non-firm actors (consulting companies, government and research institutions) is higher than those that collaborate with firm actors (clients, suppliers, competitors).

The two sub-hypotheses under hypothesis 2 are as below:

Sub-hypothesis 2a and 2b

$H2a_A$: The innovation level of firms in emerging economies that actively collaborate with ***local*** *non-firm actors* (consulting companies, government and research institutions) is higher than those that collaborate with local or global firm actors (clients, suppliers, competitors).

$H2b_A$: The innovation level of firms in emerging economies that actively collaborate with ***global*** *non-firm actors* (consulting companies, government and research institutions) is higher than those that collaborate with local or global firm actors (clients, suppliers, competitors).

Hypothesis 3

$H3_A$: The innovation level of firms in emerging economies that develop formal links with other firm and non-firm actors is higher than those that develop informal links, or have no linkages at all.

The next chapter discusses the research methodology used to test the above propositions.

CHAPTER 4: RESEARCH METHODOLOGY

4.1. Research design

The intention of this research was to find out how the characteristics and types of business networks varied among innovative firms operating in emerging economies. Secondary data (using survey methodology) from the European Union INGINEUS project was used for this analysis. Access to this data set was obtained through the Gordon Institute of Business Science (GIBS), which participated in this research project on behalf of South Africa as a country of interest. The research drew on the previous understanding of theories of business networks and innovation, and in some respects drew from relevant empirical studies from emerging economies.

The research was conducted using quantitative, descriptive methodology. According to Blumberg, Cooper and Schindler (2008, p.197), "…if the research is concerned with finding out who, what, where, when and how, then the study is descriptive".

Terre Blanche, Durrheim and Painter (2006) outlined three different means through which descriptive research explains phenomena, namely: through narrative type descriptions, classification and measuring relationships. Therefore, in this study, the statistical analysis conducted on the quantitative data aimed to extract the following:

- Narrative type descriptions were employed to describe the data set and the demographic control variables; and
- Classification and measuring relationships were used to firstly investigate possible associations between each set of business network descriptors and innovation. This analysis was then expanded to build an *a priori* model using regression

analysis to investigate the relationship between the demographics (control variables), business networks (independent variables) and innovation (dependent variable).

4.2. Population of relevance

Steyn et al. (2007) defined target populations as the total group of specific population elements or the universal collection of items to which the research study relates. In this research, all firms belonging to industries where innovation is required in emerging economies constituted the target population.

These industries were identified by each country-specific institute participating in gathering survey responses, by choosing a sector that was of economic importance within their national or regional context. Evidence suggested that the outsourcing of knowledge-intensive activity and the emerging phenomenon of knowledge creation in emerging markets is spreading from the electronics sector to many other sectors of the economy (Barnard & Ismail, 2010). Therefore, key innovation activities are found in traditional low-tech industries such as agro-processing or medium-tech such as automobile, as well as high-tech such as ICT. This formed the motivation behind the sectoral choices of the ICT, Automotive and Agro-processing sectors for this study .Companies were identified through databases of that particular sector.

4.3. Sampling frame and sample

The sampling frame is the list of elements from which a sample can be drawn; it also provides the list that can be worked with operationally (Zikmund, 2003).

The sampling frame for this research was made up of firms belonging to the agro-processing, automobile and ICT industries (the proxy for 'innovative industries') in Brazil, China, India and South Africa (the proxy for 'emerging economies').

Various country-specific databases were used to identify firms belonging to the various industries (see section **4.6** below). Convenience sampling was used to obtain those companies within the database who were most conveniently available. The benefits of this method included the ability to obtain a large number of completed questionnaires quickly and economically (Zikmund, 2003). The key disadvantage to this was that variability and bias estimates could not be measured and projecting data beyond the sample was inappropriate (Zikmund, 2003).

4.4. Unit of analysis

The unit of analysis was the firm. The representative of the firm completing the survey was viewed as a proxy for the firm itself. The information extracted from the representative of the firm was therefore extended to present the views and behaviour of the firm as an entity.

4.5. Data collection instrument: Design

The data set used for this research project was based on a questionnaire developed as part of a larger international project funded by the European Union (EU). The survey used for this study was developed to investigate the trend of emerging economies outside of the EU increasingly becoming a source for knowledge generation and the inception of ideas,

forming a so-called new "technological frontier" for the development of knowledge (Barnard & Ismail, 2010).

The questionnaire was developed through interaction and collaboration of all 8 participating country-specific institutions to this project. The questionnaire was structured to elicit information on firm behaviour around a clearly defined set of theories from the literature based on the emergence of global innovation networks (GINs), specifically:

- Individual instances of firms that constitute GINs;
- The scope of GINs;
- The determinants of GINs; and
- The impact of GINs

The institutions participating in the INGINEUS project therefore developed new measures to better illustrate the specific research context of the globalisation of innovation networks. All constructs taken from the literature were therefore modified if and where necessary to reflect the context of this study. The danger of misspecification of the firm as the level of theory and the person as the level of measurement was cautioned for, but nonetheless used as proxy (see section **4.4**).

The survey instrument consisted of 14 questions. A number of the questions had multiple sub-questions.

- **Question 1** asked the respondent to briefly describe the enterprise's main product (goods or services). The respondent was then directed to a menu which allowed them to select the option which best described the firm's main area of focus;
- **Questions 2 to 4** elicited background information about firm size, market, sales information and R&D activity;

- **Questions 5 and 6** were innovation based questions;
- **Questions 7 and 8** probed the firms geographic network and collaborations with customers, suppliers, Universities, research institutions, government etc.;
- **Questions 9 and 10** were detailed questions around offshoring and regional attractiveness;
- **Questions 11, 12 and 13** were policy based questions; and
- **Question 14** examined the impact of the global economic crisis on innovative activity.

Based on the research questions identified in Section **3**, this research project only focused on certain specific constructs. Every objective of this research had at least one question related to it in the questionnaire. Different measures were used for the different constructs to ensure they correctly spoke to the referent in the analysis. The questions were tested against existing similar questionnaires to ensure it covers all the key aspects of the constructs.

A copy of the questionnaire is included in **Appendix 1**.

Cronbach's alpha was calculated for the constructs of Collaboration type and Linkage type to determine the internal consistency or average correlation of the particular items in the survey instrument to gauge its reliability (Pallant, 2010, p.97). A reliability coefficient of .70 or higher is considered “acceptable" in most social science research situations (Cannon, 1999). As alpha values are sensitive to the number of items on the scale, Cronbach values of .50 and higher are acceptable for scales with fewer than ten items (Pallant, 2010).

The Cronbach's alphas for relevant measures and is presented in Table 4.5.

TABLE 4.5

OVERVIEW OF RELIABILITY MEASURES FOR SCALES

Construct	Related question	Scale		Internal consistency reliability
Source of technology	5	- We produce most technological inputs in-house - We buys most of our inputs from other branches of our own MNC - We buy most of our technological inputs from non-MNC firms - We buy most of our inputs from MNCs with which we are not formally connected - We buy most of our inputs from public-sector organisations, e.g. research institutes, universities etc		$\mu = 0.178$
Collaboration type	7	- Clients - Suppliers - Competitors - Consultancy companies - Government - Local universities/ research institutions/ labs - Foreign universities/ research institutions/ labs - Other	- Your region - Your country - North America - South America - Western Europe - Central & Eastern Europe - Africa - Japan & Australasia - Rest of Asia	$\alpha = 0.890$
Linkage type	8	- Clients - Suppliers - Competitors - Consultancy companies - Government - Local universities/ research institutions/ labs - Foreign universities/ research institutions/ labs - Other	- Yes, formal - Yes, informal - No	$\alpha = 0.606$

With very short scales, like the one used to measure the construct *Source of technology*, it is more appropriate to report the mean inter-item correlation for the items. Briggs and Cheek (1986) recommended an optimal range for the inter-item correlation of 0.2 to 0.4.

4.6. Data collection

The data was collected as part of the INGINEUS project, a research project run by the European Union (EU) and in which the Gordon Institute of Business Science (GIBS) participates on behalf of South Africa as a country of interest.

The survey could be delivered electronically by mail or link (using *SurveyMonkey*, an online survey tool), by face-to-face interviews, through telephonic interviews or by written mail. This choice was left up to the delivering institute based on their past experience of survey dissemination and their historical knowledge of the best methods utilised for high response rates. Administration choice is summarised in Table **4.6a**.

TABLE 4.6a

DATA COLLECTION METHOD BY COUNTRY

	Electronic channels	Face-to-face interviews	Telephonic channels
Brazil		X	X
China			X
India	X	X	
South Africa	X		

The purpose of using a common survey tool which looked exactly the same across all survey countries was intended to assist with consistency across the project, streamline the research processes and to simplify the assimilation of the data at the end (Barnard & Ismail, 2010). Further benefits of this data collection method include: the speed of data collection (online access 24/7); low cost; low threat of interviewer influence on answers; versatility of questioning and high geographic flexibility (Zikmund, 2003).

While each country was required to set up their own online survey tool through *SurveyMonkey*, the relevant 'Username' and 'Password' for the country-specific site was sent through to UP-GIBS. In this way the survey progress could be monitored from a central site. However, three of the four countries representing the emerging markets (except for China) opted to conduct the questionnaires either in person or telephonically in order to increase response rates, and only later entered the data into the shared survey software.

Each participating country administered the survey to a nationally representative database based on their specific sector. A summary of each country-specific approach is presented below.

- **Brazil**

  The survey partner was required to create a composite database built from 3 separate databases (RAIS, SINDIPECAS and Supplier Case List) in order to create a representative sample. The historically poor response rate to mailed and electronic surveys meant that interviews would have to be conducted face-to- face. The survey was confined to the region of Minas Gerais. The Brazilian automotive industry is however concentrated in the region, therefore the majority of the relevant auto firms were represented in the databases.

- **China**

  The vastness of the geography and the sheer number of ICT firms nationally made it very difficult to access and approach firms with the survey. In China, face-to-face interviews or telephone interviews were found to offer the highest response rate. These challenges necessitated a regional approach - two regional databases were used, one focussing on Beijing and the other on Shenzen.

- **India**

  The historical difficulties with low electronic response rate required that a face-to-face interview strategy be implemented. Since it was not viable to conduct this nationally, a regional profiling of the NASSCOM database was undertaken. Cities with IT-dense clusters were chosen as targets for the survey. These cities represented 93% of all the firms in the database. These cities included Bangalore, Delhi, Mumbai, Pune, Trivandrum, Hyderabad and Kochi.

- **South Africa**

  A composite agro-processing database was created from 4 separate databases as the databases acquired were not updated and had a large number of invalid contacts. In South Africa, the project was run as follows:

  i. Databases were identified;
  ii. An online survey tool was set up with an e-mail link facility;
  iii. Each contact (minus repetitions) on the database was called, given a description of the survey and its relevance and asked to participate;
  iv. The persons contacted who agreed to participate were then sent the survey link electronically; and
  v. Those contacts who agreed to participate but who failed to submit their survey responses were contacted again two weeks later. If they failed to respond to this reminder a final reminder was sent again 2 weeks later.

TABLE 4.6b

SURVEY RESULTS BY COUNTRY AND INDUSTRY

(number of responses and response rates in brackets)

Countries	ICT	Auto	Agro	TOTAL
Brazil		69 (25.9%)		
China	243 (2.7%)			
India	324 (25.2%)			
South Africa			84 (16.9%)	
TOTAL emerging markets	**567**	**69**	**84**	**720**

The combined INGINEUS sample was dominated by ICT responses. This was in part due to the size of India and China, but also due to the more established and thus concentrated nature of the agro-processing and auto industries. Although China had the second-highest number of responses, it also had the lowest response rate (2.7%). This is because the Chinese team had opted to choose a broader sample and use a less labour-intensive strategy for targeting respondents.

4.7. Data analysis

4.7.1. Dependent variable

The dependent variable for this study was *Level of innovation* and it was operationalised using Question 6 from the questionnaire. This question prompted respondents to provide information regarding product and/ or process innovation experienced in the firm between 2006 and 2008. The sub-questions (6.1 – 6.5) covered different *types* of innovation, being:

i. New products

ii. New services

iii. New or significantly improved methods of manufacturing or producing

iv. New or significantly improved logistics, distribution or delivery methods for inputs, goods and services

v. New or significantly improved supporting activities for processes (e.g. purchasing, accounting, maintenance systems etc.)

The four options available for each of the sub-questions indicated *level* of innovation, being new to the world, new to the industry, new to the firm or none. *New to the world* indicated the highest level of innovation).

A scoring system was devised to operationalise the dependent variable. A formula was devised that gave each case in the data set a continuous value ≥ zero. This value was divided by the maximum value of the data set, so that each case had a continuous score between 0 and 1; with each case with a score of 1 being those cases which most epitomised innovation. Based on this, each case could then be compared to each other case in the data set.

Following the determination of the *innovation score* (continuous variable), it was then proceeded to determine an *innovation level* (categorical variable). Scores were displayed on a scatter plot to visually examine the graphical layout of the data points (Albright, Winston & Zappe, 2009, p. 575). A “natural break” in the scores was specified as the “cut-off point” for a specific level of innovation.

Cluster analysis was used to identify associations among data points (Albright et al., 2009, p.146), serving as a base from which to identify cut-off points, but intuition was the final decision-maker, and several times the cluster analysis was rejected in favour of a more obvious break point identified by inspection of the scatter plot. All values above the cut-off

point were given as capital letters and all values below were given as lower case letters. This is presented in **Table 4.7.1**.

TABLE 4.7.1

OPERATIONALISATION OF THE DEPENDENT VARIABLE: *LEVEL OF INNOVATION*

Value label	Range of possible values	Operationalised meaning
*	0	No innovation
i	< 0.6	Low innovation
I	≥ 0.6	High innovation

A previous study (Vincent, Bharadwaj & Challagalla, 2004) found that using a dichotomous measure of innovation deflates observed effect sizes, while studying innovation cross-sectionally and within one industry sector inflates the observed effect. In order to mitigate for these findings, the innovation *score* and the innovation *level* were both used as *Level of innovation* in the statistical methodology depending on the type of analysis required to describe the data set. Innovation *level* (*****, **i** or **I**) was used as a categorical variable in crosstabulations and chi-squared tests, while innovation score was preferred as a more sophisticated rating scale (bounded from 0 to 1) when the multiple regression was applied. Furthermore, the final regression model included two different industry sectors.

Of the firms included in the original data set (*n* = 720), approximately a quarter reported no innovation (***** = 23.3%). The majority reported low levels of innovation (**i** = 70%), and only 48 firms reported high levels of innovation (**I** = 6.67%). As shown in **Chapter 5**, this variable is not highly internally correlated. This is consistent with prior research on the unequal development of process and product capabilities within firms in emerging markets, as well as the industrialised world, reported in McDermott and Corredoira (2010).

4.7.2. Control variables

Given the cross-sectional nature of the data set, in an effort to reduce concerns regarding endogeneity, several variables were introduced that accounted for firm characteristics as thoroughly as possible, within the limitations of the questionnaire. In multivariate analysis, these variables were "forced" into the analysis as the first block of variables, which has the effect of statistically controlling for these variables (Pallant, 2011, p.163).

The primary purpose of control variables is to rule out potential alternative explanations. In this study, these variables also represent those commonly used to describe the demographics of firms in strategic research at firm level and are presented in **Table 4.7.2**.

TABLE 4.7.2

CONTROL VARIABLE DESCRIPTIONS

Control variable	Type	Description	Question of origin
Country	Categorical	Country of orgin headquarters of the firm	
Industry	Categorical	Industry for w hich the firm produces its main product (goods or services)	1.1
Company structure	Categorical	Relationship in terms of headquarters and subsidiaries	2
Company size	Categorical	Number of full-time emplyees at firm	3.1
Sales	Categorical	Does the firm have a significant share of sales activity abroad	3.2
% sales from exports	Continuous	Percentage (%) of total sales derived from export	3.2.1
Geographical market	Categorical	The firm's largets market in geographical terms	4.1

4.7.3. Independent variables

The hypotheses (1, 2a and b, and 3) were tested through variables that captured the nature of business networks between firm actors (clients, suppliers and competitors) and non-firm actors (consultancy companies, government, universities and research institutions). The nature of business networks was conceptualised as channels that facilitate innovation (and information and knowledge) transfer, and may assist firms in developing new products and processes through collaboration. Measures were constructed by analysing the responses collected through the questionnaire from firms about their interactions with other firm and non-firm actors. This captured the ability of the respondent firms to receive a wide range of information through the other actors through these ties and linkages.

Particular attention was paid to the existence of collaboration and linkages (Borgatti, 2005). Strength and quality were operationalised in a similar way as level of innovation. This was achieved by weighting a focal firm's tie to a type of actor (firm or non-firm) by the reported frequency of interaction (Burt, 1983).

The data from the questionnaire was characterised into nine independent variables representing the sub-elements of the various hypotheses. Only some of the relevant questions from the questionnaire were used for this purpose. These variables are identified in **Table 4.7.3a**.

TABLE 4.7.3a

INDEPENDENT VARIABLE DESCRIPTIONS

	Independent variable	Type	Description	Question of origin
x1	**Technology source**	Categorical	What is the most important source of technology for the firm?	5
	Collaboration type		Who did the firm actively collaborate with to develop innovation and in which geographical location?	7
x2a	Firm actors: Local	Count		
x2b	Non-firm actors: Local	Count		
x3a	Firm actors: Global	Count		
x3b	Non-firm actors: Global	Count		
	Linkage type		Has the enterprise developed formal/ informal linkages with foreign organisations to develop innovation?	8
x4a	Firm actors: Formal	Count		
x4b	Non-firm actors: Formal	Count		
x5a	Firm actors: Informal	Count		
x5b	Non-firm actors: Informal	Count		
x6a	Firm actors: None	Count		
x6b	Non-firm actors: None	Count		

The variables x2 to x6 (with the exception of variable x1, based on a single question), were created by giving equal weight to the responses given by each sub-question. For example, Question 7.1 represented the firm actor *Clients* and elicited information on the geographical location of the collaboration being *Local* (your region or your country) or *Global* (North America, South America, Western Europe, Central & Eastern Europe, Africa, Japan & Australasia and Rest of Asia) respectively. Responses from all these collaboration categories were given equal weight and combined to create the variables x2a (Clients and Local = Firm actors: Local) and x2b (Clients and Global = Firm actors: Global).

The responses to the questions needed to be statistically analysed. In order to do this, a code was developed to translate the responses into numeric format.

Table **4.7.3b** is the summary of the codification of the responses to questions 7 and 8.

TABLE 4.7.3b

QUESTION CODE TABLES

QUESTION 7: COLLABORATION TYPE

		Your region	Your country	Aggregated index: Firm actors: Local
7.1	Clients	0* = No	1* = Yes	0 - 6
7.2	Suppliers			
7.3	Competitors			

		North America	South America	Western Europe	Central & Eastern Europe	Africa	Japan & Australasia	Rest of Asia	Aggregated index: Firm actors: Global
7.1	Clients			0* = No	1* = Yes				0 - 21
7.2	Suppliers								
7.3	Competitors								

		Your region	Your country	Aggregated index: Non-firm actors: Local
7.4	Consultancy companies	0* = No	1* = Yes	0 - 10
7.5	Government			
7.6	Local Universities/ Research Institutions/ Labs			
7.7	Foreign Universities/ Research Institutions/ Labs			
7.8	Other			

		North America	South America	Western Europe	Central & Eastern Europe	Africa	Japan & Australasia	Rest of Asia	Aggregated index: Non-firm actors: Global
7.4	Consultancy companies			0* = No	1* = Yes				0 - 35
7.5	Government								
7.6	Local Universities/ Research Institutions/ Labs								
7.7	Foreign Universities/ Research Institutions/ Labs								
7.8	Other								

* Coded value

TABLE 4.7.3b (continued)

QUESTION CODE TABLES

QUESTION 8: LINKAGE TYPE

		Yes, formal	Aggregated index: Firm actors: Formal
8.1	Clients	0* = No 1* = Yes	0 - 3
8.2	Suppliers		
8.3	Competitors		

		Yes, informal	Aggregated index: Firm actors: Informal
8.1	Clients	0* = No 1* = Yes	0 - 3
8.2	Suppliers		
8.3	Competitors		

		No	Aggregated index: Firm actors: None
8.1	Clients	0* = No 1* = Yes	0 - 3
8.2	Suppliers		
8.3	Competitors		

		Yes, formal	Aggregated index: Non-firm actors: Formal
8.4	Consultancy companies	0* = No 1* = Yes	0 - 4
8.5	Government		
8.6	Foreign Universities/ Research Institutions/ Labs		
8.7	Other		

		Yes, informal	Aggregated index: Non-firm actors: Informal
8.4	Consultancy companies	0* = No 1* = Yes	0 - 4
8.5	Government		
8.6	Foreign Universities/ Research Institutions/ Labs		
8.7	Other		

		No	Aggregated index: Non-firm actors: None
8.4	Consultancy companies	0* = No 1* = Yes	0 - 4
8.5	Government		
8.6	Foreign Universities/ Research Institutions/ Labs		
8.7	Other		

* Coded value

The elements from **Table 4.7.3b** that are worth noting are as follows:

- An aggregate index for *Firm actors: Local* (Question 7.1 – 7.3) was created by adding the codes from the responses to the type of firm actor collaboration activities (clients, suppliers, competitors) within the local geography (own region or country) a firm was engaged with. Therefore, if firms did not collaborate with any local firm actor it would have an aggregated index value of 0, while if a firm engaged with all local firm actors it would have a value of 6 (1+1+1+1+1+1). For any other combination it would have a value between and including 1 and 5.
- A similar strategy was adopted for all the other aggregated indices presented in **Table 4.7.3b**.
- With regards to the variables *Firm actors: None* and *Non-firm actors: None*. Answering "Yes" to one of these questions seems counter-intuitive, but as the study was interested in the impact of linkages (or lack thereof) with regard to the level of innovation, an indication of no linkage was considered significant.

4.7.4. A multiple regression model

To further testing the hypotheses presented, a model was built to predict whether a firm would have a high level of innovation or not given the nature of the business networks that it had cultivated (explanatory variable).

In order to build this model, hierarchical multiple regression was used. The technique involves that "…the independent variables are entered into the (regression) equation in an order specified by the researcher based on theoretical grounds" (Pallant, 2011, p. 149). Regression was therefore useful in analysing problems where there were two or more

continuous or dichotomous independent variables (the control variables, and independent variables x1 to x3f) and a continuous dependent variable (level of innovation).

The research questions and data set conformed to all the assumptions and requirements for using multiple regression (Brace, Kemp & Snelgar, 2006, p.208):

- The data set depicts a linear relationship and the research question aims to explore the nature of this relationship;
- The criterion variable that you are seeking to predict (*Level of innovation*) should be measured on a continuous scale;
- The predictor variables (control variables and independent variables) would be measured on ratio, interval or ordinal scales; and
- The number of cases must substantially exceed the number of predictor variables – in this case 80:1 (acceptable ratio 10:0 and 40:1 for certain statistical selection methods).

The following equation explains the multiple regression equation:

$$Y = a + b_1X_1 + b_2X_2 + \ldots + b_kX_k$$

If *Y* is the dependent variable (*Level of innovation*) and X_1 through X_k are the explanatory variables, then *a* is the *Y*-intercept and b_1 through b_k are the slopes. The intercept *a* is the expected value of *Y* when all of the explanatory variables equal zero. Each slope coefficient is the expected change in *Y* when the particular *X* increases by one unit and any other *X* in the equation remains constant.

In order to make the model more granular in terms of the predictive role of various aspects of the control variables, dummy variables and baselines were used as opposed to the aggregated composite variables. This follows the principle of adding more characteristics

(variables) in the equation to reduce the deviance (especially in terms of multicollinearity) and thereby improve the stability and fit of the model (Pallant, 2011; Licht, 1995).

The aim of regression was to come up with a model which predicted the odds and thereby the probability of a firm being highly innovative. In order to do this:

i. Initial hierarchical stepwise regression was conducted with all the control variables and all the independent variables (as mentioned above). The various characteristics of the model were looked into – the standardised regression coefficients as well as design considerations such as multicollinearity and the variance inflation factors (VIF). Finally, the model was assessed to determine its validity in terms of the R square and adjusted R square and the statistical significance of each independent variable.

ii. If multicollinearity was found to be present, the variables in the model had to be adjusted if they were considered to be important not to cause specification errors. Furthermore, predictor variables with high levels of VIF had to be excluded from the model. The model as a whole was evaluated, after which the impact of each of the remaining independent variables had to be determined.

iii. Different models were evaluated in order to find the most optimal model to predict the dependent variable. A summary of the final selection of evaluated options and results is presented in **Chapter 5**. This also includes the rationale for selecting the final model.

4.8. Research limitations

Limitations based on the intended scope and the design of the research is acknowledged as follows:

- Non-response and response bias in terms of the data collection of the questionnaire;
- Several data collectors in different countries were used to collate the data set. This gave rise to challenges around consistency of understanding the questions and codification of the responses. As described in Section **4.6** it also gave rise to different data collection methods depending on country-specific culture and acceptability. However, in order to mitigate this risk, the data was extensively checked by the collective research team, with representatives from each country.
- There are a large number of factors that can influence innovation in an organisation, and the interaction between them is decidedly complex. This study focused only on the impact of business networks on innovation.
- This study focused only on agro-processing, automotive and ICT industries as proxies for industries in emerging countries. Furthermore, it only included Brazil, China, India and South Africa as proxies for all emerging market economies. Several other industries as well as countries need to be included in the scope of future research to make a better generalisation of findings.

In the next chapter, the results of the study are discussed based on the above methodology.

CHAPTER 5: RESULTS

This section firstly describes participant responses, followed by some salient findings in terms of the type of business networks companies employ in emerging markets. These characteristics were discovered from the responses of the firms to the various questions from the questionnaire. The section then addresses in more detail, the technology sources, collaboration types and linkage types used in business networks. Finally the factors impacting on innovation were linked to the hypotheses of this research.

In order to describe these factors, the data was analysed in the following broad steps:

i. The first step was the descriptive analysis of the data. This was done by analysing the frequency tables constructed from the responses of the firms to the various questions in the questionnaire. The outcome of this step was to establish if there was any existent pattern of differences in terms of the various characteristics of business networks between the various firms.

ii. The second step was to run the chi-square tests per characteristic or factor of business network. The associated crosstabulations and histograms assisted in visualizing the probability distribution and the percentile distribution of the data respectively, while the chi-square values and the associated probability in the t-tests confirmed if the pattern observed in step 1 was statistically significant.

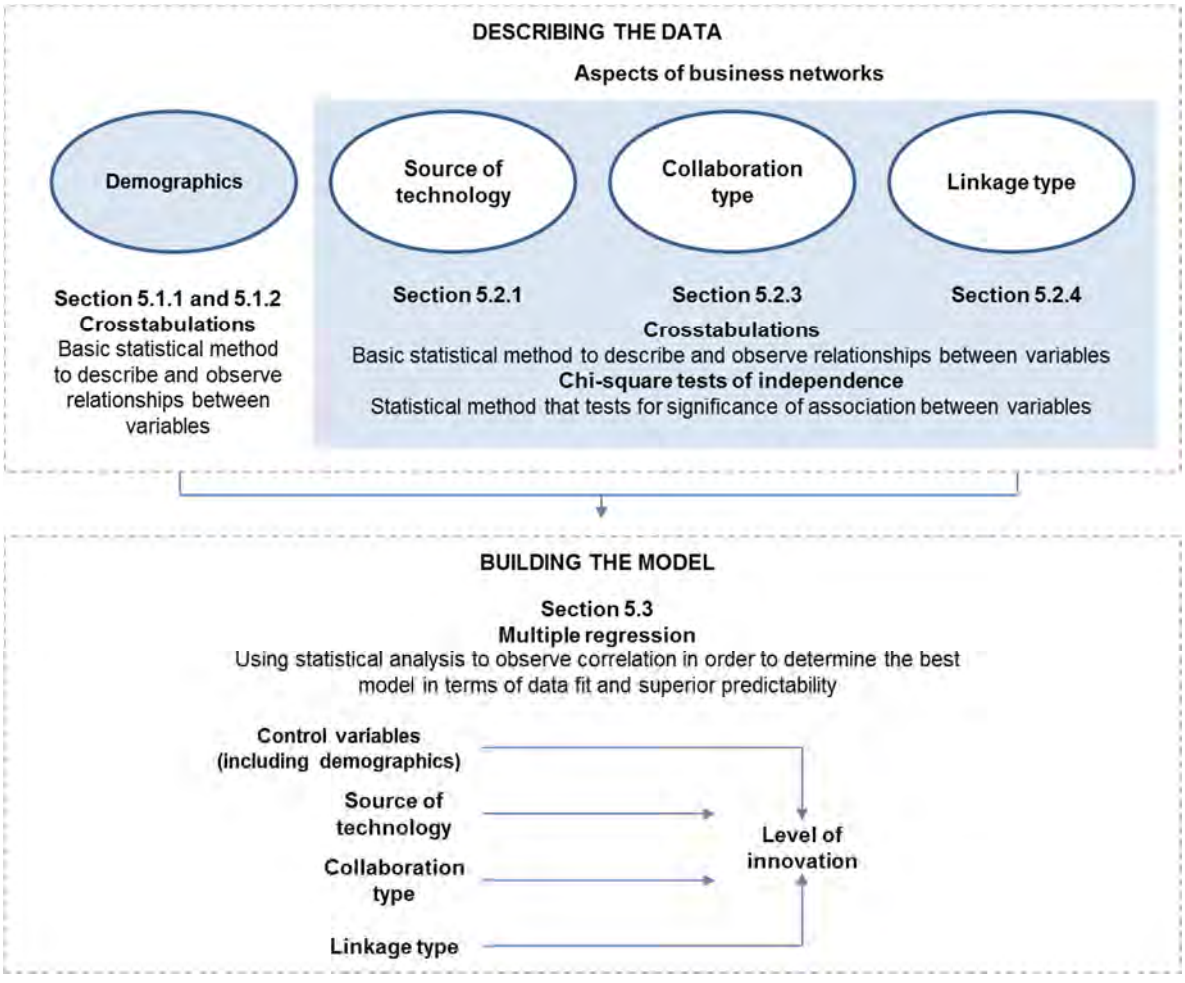
iii. Finally, a hierarchical multiple regression was run on all the characteristics of business networks, including the control variables, showing a pattern which was found to be statistically significant individually. This step was to find jointly how the various factors/ characteristics of business networks contributed to and impacted on the different levels of innovation. This model took the interdependency of all the

characteristics into account. Also, this step confirmed there was a correlation between the innovativeness (dependent variable) of a firm and the various characteristics of its business network(s) (independent variables).

These steps are summarized in **Diagram 5**.

DIAGRAM 5

SUMMARY OVERVIEW OF ANALYTICAL APPROACH



5.1. Participant response and background

5.1.1. Participant response

Responses of 720 firms operating in emerging markets were gathered through the INGINEUS questionnaire. The response rate within countries was relatively low, especially in China where the research team decided on a less labour-intensive strategy to gather data. The response rate between the four countries was 25.9% in Brazil, 2.7% in China, 25.2% in India and 16.9% in South Africa. Though Brazil had the highest internal response rate (25.9%), India had the largest number of responses (324 respondents).

TABLE 5.1.1

PARTICIPANT RESPONSE RATES

	Number of responses	Response rate
Brazil	69	**25.9%**
China	243	2.7%
India	**324**	25.2%
South Africa	84	16.9%

The total number of responses was considered satisfactory for the purposes of conducting quantitative research. In terms of number of responses, India had the highest number being 324. With an increase of the sample size (*n*), sampling error and uncertainty decrease. "…if *n* is reasonably large, there is about 95% chance that the magnitude of the sampling error will be no more than 2 standard errors" (Albright, Winston & Zappe, 2009, p.417). With increasing *n* which implies greater degrees of freedom (larger than 30), the sample distribution is expected to adequately approximate the population distribution (Albright et al., 2009, p.435).

In order to conduct a multivariate analysis, the degrees of freedom (*df*) is defined as:

$$df = n - k - 1$$

where *n* = number of data points and *k* = number of variables.

Here

In the case of Brazil, *df* = 69 – 9 - 1 = 59, which was greater than 30

In the case of China, *df* = 243 – 9 – 1 = 233, which was greater than 30

In the case of India, *df* – 324 – 9 – 1 = 314, which was greater than 30

In the case of South Africa, *df* = 84 – 9 – 1 = 74, which was greater than 30

Similar calculations were performed for each of the variables used in testing the various hypotheses, all yielding *df* > 30. Therefore the sample size was large enough so that the sample distribution approximated the population distribution adequately.

5.1.2. Background of the firms in emerging markets

As described in section 5.1.1 above, most of the respondents were firms in India (45%). Across the board, most of the responding firms were in the ICT sector (78.9%) with an equal number of firms in the agro-processing and automotive industries (9.9% each). Most firms were standalone (46.7%), with about a quarter of respondents being the subsidiaries of multinational corporations (MNC's) (27.4%) and the remainder indicating that they were the headquarters of an emerging market multinational (16.4%). Most of the firms were operating in the SMME sector with less than 10 full-time employees (40.3%). This was consistent with literature on emerging market economies as well as firms operating in the ICT sector, pointing to the proliferation of small ventures.

The share of location of sales activity were fairly equally distributed between firms, with 41.3% indicating a significant number of their sales that can be attributed to foreign markets, while 51.4% indicated no significant sales activity abroad. Of the total sample, 58.6% of the market for these firms was internal to the enterprise, regional or national, with 34.2% of firms saw exports as the key market for their product.

Table **5.1.2** is the summary of demographics of the sample:

TABLE 5.1.2

SUMMARY OF DEMOGRAPHICS

COUNTRY OF ORIGIN

	Count	Percent
Brazil	69	9.6%
China	243	33.8%
India	324	45.0%
South Africa	84	11.7%

INDUSTRY

	Count	Percent
Agro-processing	71	9.9%
ICT	568	78.9%
Automotive	71	9.9%
No information	10	1.4%

COMPANY STRUCTURE TYPE

	Count	Percent
Standalone	336	46.7%
Subsidiary of MNC	197	27.4%
Headquarters of MNC	118	16.4%
No information	69	9.6%

SIZE (based on number of employees)

	Count	Percent
< 10 FTE	290	40.3%
10 - 49 employees	109	15.1%
50 - 249 employees	120	16.7%
250 - 999 employees	70	9.7%
1000 or more	51	7.1%
No information	80	11.1%

SIGNIFICANT SALES ACTIVITY ABROAD

	Count	Percent
Yes	297	41.3%
No	370	51.4%
No information	53	7.4%

GEOGRAPHY OF FIRM'S LARGEST MARKET

	Count	Percent
Internal to enterprise	14	1.9%
Regional	97	13.5%
Domestic (national)	311	43.2%
Export	246	34.2%
No information	52	7.2%

In order to create a better understanding of the demographic spread of the control variables, crosstabulations were performed with the dependent variable (DV), level of innovation. Each of these are discussed separately below.

5.1.2.1. Demographics of country, industry and level of innovation

These demographics were gathered from the company identification tag and Question 1 in the questionnaire. The overview of the crosstabulation between the control variable for country and the dependent variable of level of innovation is presented below.

TABLE 5.1.2.1a

CROSSTABULATION COUNTRY * LEVEL OF INNOVATION

			Level of innovation			Total
			*	i	I	
Country	Brazil	Count	10	59	0	69
		% within *Country*	14.5%	85.5%	0.0%	100%
		% within *Level of innovation*	6.0%	11.7%	0.0%	9.6%
		% of Total	1.4%	8.2%	0.0%	9.6%
	China	Count	90	134	19	243
		% within *Country*	37.0%	55.1%	7.8%	100%
		% within *Level of innovation*	53.6%	26.6%	39.6%	33.8%
		% of Total	12.5%	18.6%	2.6%	33.8%
	India	Count	63	249	12	324
		% within *Country*	19.4%	76.9%	3.7%	100%
		% within *Level of innovation*	37.5%	49.4%	25.0%	45.0%
		% of Total	8.8%	34.6%	1.7%	45.0%
	South Africa	Count	5	62	17	84
		% within *Country*	6.0%	73.8%	20.2%	100%
		% within *Level of innovation*	3.0%	12.3%	35.4%	11.7%
		% of Total	0.7%	8.6%	2.4%	11.7%
	Total	Count	168	504	48	720
		% within *Country*	23.3%	70.0%	6.7%	100%
		% within *Level of innovation*	100%	100%	100%	100%
		% of Total	23.3%	70.0%	6.7%	100%

Of the overall population, China had the largest number of firms with high levels of innovation (39.6%) followed by South Africa (35.4%). Comparing this to the number of firms within each country, South Africa had the largest percentage of firms with high levels of innovation (20.2%).

The overview of the crosstabulation between the control variable for industry and the dependent variable of level of innovation is presented below.

TABLE 5.1.2.1b

CROSSTABULATION INDUSTRY * LEVEL OF INNOVATION

			Level of innovation			Total
			*	i	I	
Industry	**Agro-processing**	Count	3	55	13	71
		% within *Industry*	4.2%	77.5%	18.3%	100%
		% within *Level of innovation*	1.8%	10.9%	27.1%	9.9%
		% of Total	0.4%	7.6%	1.8%	9.9%
	Automotive	Count	10	61	0	71
		% within *Industry*	14.1%	85.9%	0.0%	100%
		% within *Level of innovation*	6.0%	12.1%	0.0%	9.9%
		% of Total	1.4%	8.5%	0.0%	9.9%
	ICT	Count	153	383	32	568
		% within *Industry*	26.9%	67.4%	5.6%	100%
		% within *Level of innovation*	91.1%	76.0%	66.7%	78.9%
		% of Total	21.3%	53.2%	4.4%	78.9%
	No information	Count	2	5	3	10
		% within *Industry*	20.0%	50.0%	30.0%	100%
		% within *Level of innovation*	1.2%	1.0%	6.3%	1.4%
		% of Total	0.3%	0.7%	0.4%	1.4%
	Total	Count	168	504	48	720
		% within *Industry*	23.3%	70.0%	6.7%	100%
		% within *Level of innovation*	100%	100%	100%	100%
		% of Total	23.3%	70.0%	6.7%	100%

Innovation across industries seems to be centered on the central level of innovation (**i**). Consistent with the literature, the ICT-sector had the highest proportion of innovative companies (66.7% of all high innovation companies across all industries). The automotive industry had the highest average level of innovation with 85.9% of firms indicating central levels of innovation (**i**).

5.1.2.2. Demographics of company structure, number of employees and level of innovation

These demographics were gathered from Questions 2 and 3.1 in the questionnaire. The overview of the crosstabulation between the control variable for firm structure and the dependent variable of level of innovation is presented below.

TABLE 5.1.2.2a

CROSSTABULATION FIRM STRUCTURE * LEVEL OF INNOVATION

			Level of innovation			Total
			*	i	I	
Firm structure	Standalone company	Count	76	234	26	336
		% within *Firm structure*	22.6%	69.6%	7.7%	100%
		% within *Level of innovation*	45.2%	46.4%	54.2%	46.7%
		% of Total	10.6%	32.5%	3.6%	46.7%
	Subsidiary of an MNC	Count	38	147	12	197
		% within *Firm structure*	19.3%	74.6%	6.1%	100%
		% within *Level of innovation*	22.6%	29.2%	25.0%	27.4%
		% of Total	5.3%	20.4%	1.7%	27.4%
	Headquarters of an MNC	Count	43	71	4	118
		% within *Firm structure*	36.4%	60.2%	3.4%	100%
		% within *Level of innovation*	25.6%	14.1%	8.3%	16.4%
		% of Total	6.0%	9.9%	0.6%	16.4%
	No information	Count	2	5	3	10
		% within *Firm structure*	20.0%	50.0%	30.0%	100%
		% within *Level of innovation*	1.2%	1.0%	6.3%	1.4%
		% of Total	0.3%	0.7%	0.4%	1.4%
	Total	Count	168	504	48	720
		% within *Firm structure*	23.3%	70.0%	6.7%	100%
		% within *Level of innovation*	100%	100%	100%	100%
		% of Total	23.3%	70.0%	6.7%	100%

Standalone companies had the highest percentage of representatives within the highest innovation category (**I** = 54.2%). The overall highest levels of innovation were found in standalone companies (i = 32.5%) and subsidiaries of MNC's (20.4%).

The overview of the crosstabulation between the control variable for firm structure and the dependent variable of level of innovation is presented below.

TABLE 5.1.2.2b

CROSSTABULATION FIRM SIZE * LEVEL OF INNOVATION

			Level of innovation			Total
			*	i	I	
Firm size	**< 10 full-time employees**	Count	62	216	12	290
		% within *Firm size*	21.4%	74.5%	4.1%	100%
		% within *Level of innovation*	36.9%	42.9%	25.0%	40.3%
		% of Total	8.6%	30.0%	1.7%	40.3%
	10 - 49 employees	Count	31	65	13	109
		% within *Firm size*	28.4%	59.6%	11.9%	100%
		% within *Level of innovation*	18.5%	12.9%	27.1%	15.1%
		% of Total	4.3%	9.0%	1.8%	15.1%
	50 - 249 employees	Count	41	69	10	120
		% within *Firm size*	34.2%	57.5%	8.3%	100%
		% within *Level of innovation*	24.4%	13.7%	20.8%	16.7%
		% of Total	5.7%	9.6%	1.4%	16.7%
	250 - 999 employees	Count	18	48	4	70
		% within *Firm size*	25.7%	68.6%	5.7%	100%
		% within *Level of innovation*	10.7%	9.5%	8.3%	9.7%
		% of Total	2.5%	6.7%	0.6%	9.7%
	1000 or more employees	Count	10	39	2	51
		% within *Firm size*	19.6%	76.5%	3.9%	100%
		% within *Level of innovation*	6.0%	7.7%	4.2%	7.1%
		% of Total	1.4%	5.4%	0.3%	7.1%
	No information	Count	6	67	7	80
		% within *Firm size*	7.5%	83.8%	8.8%	100%
		% within *Level of innovation*	3.6%	13.3%	14.6%	11.1%
		% of Total	0.8%	9.3%	1.0%	11.1%
	Total	Count	168	504	48	720
		% within *Firm size*	23.3%	70.0%	6.7%	100%
		% within *Level of innovation*	100%	100%	100%	100%
		% of Total	23.3%	70.0%	6.7%	100%

The majority of firms had less than 10 full-time employees (40.3%), which place them firmly in the SMME-sector. This is consistent with the literature which indicated that emerging markets are characterised by a proliferation of smaller firms rather than large

conglomerates. These firms and the category one up (10 – 49 employees) also had the largest percentages of high levels of innovation (**I** = 25% and **I** = 27.1% respectively). In contradiction, very small firms (<10 FTE's) also had the largest percentage of no or very low levels of innovation (36.9%).

5.1.2.3. Demographics of market geography and size and level of innovation

These demographics were gathered from Questions 3.2 and 4.1 in the questionnaire. The overview of the crosstabulation between the control variable for sales activity abroad and the dependent variable of level of innovation is presented below.

TABLE 5.1.2.3a

CROSSTABULATION SALES ACTIVITY ABROAD * LEVEL OF INNOVATION

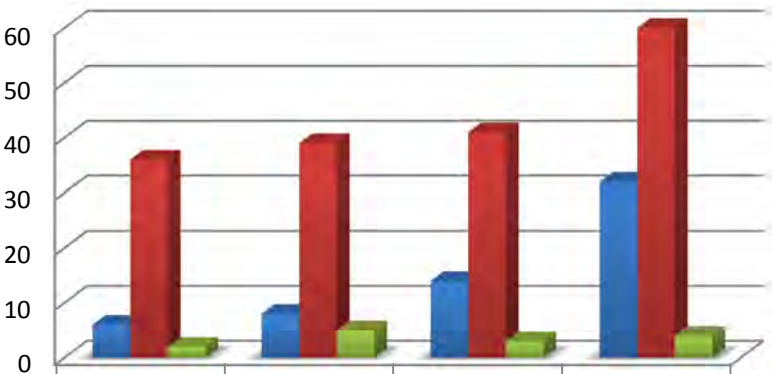
			Level of innovation			Total
			*	i	I	
Sales activity abroad	Yes	Count	75	207	15	297
		% within *Sales activity*	25.3%	69.7%	5.1%	100%
		% within *Level of innovation*	44.6%	41.1%	31.3%	41.3%
		% of Total	10.4%	28.8%	2.1%	41.3%
	No	Count	90	253	27	370
		% within *Sales activity*	24.3%	68.4%	7.3%	100%
		% within *Level of innovation*	53.6%	50.2%	56.3%	51.4%
		% of Total	12.5%	35.1%	3.8%	51.4%
	No information	Count	3	44	6	53
		% within *Sales activity*	5.7%	83.0%	11.3%	100%
		% within *Level of innovation*	1.8%	8.7%	12.5%	7.4%
		% of Total	0.4%	6.1%	0.8%	7.4%
	Total	Count	168	504	48	720
		% within *Sales activity*	23.3%	70.0%	6.7%	100%
		% within *Level of innovation*	100%	100%	100%	100%
		% of Total	23.3%	70.0%	6.7%	100%

The majority of participating firms (51.4%) did not declare a significant share of sales activity abroad, while 41.3% indicate that they did. The number of firms with high levels of innovation was less for exporters (31.3%) than for those who did not have a significant share of their market abroad (56.3%). This is consistent with the literature indicating that firms with smaller markets have are forced to become more innovate to retain market share than those that have access to larger markets.

For the firms that did indicate significant sales activity abroad (*n* = 297), the distribution of the percentage of sales was further investigated. This is presented in the histogram below.

FIGURE 5.1.2.3a

HISTOGRAM OF PERCENTAGE (%) OF TOTAL SALES DERIVED FROM EXPORT



	1 - 25%	26 - 50%	51 - 75%	76 - 100%
*	6	8	14	32
i	36	39	41	60
l	2	5	3	4

The histogram supports the crosstabulation in **Table 5.1.2.3a** above, in that the largest number of high innovation firms (5) fell within the 26% - 50% bracket of total sales derived from export. Most firms that indicated a significant percentage of sales derived from export (76% - 100% bracket) also had low levels of innovation (***** = 32 and **i** = 60, respectively).

The overview of the crosstabulation between the control variable for market geography and the dependent variable of level of innovation is presented below.

TABLE 5.1.2.3b

CROSSTABULATION MARKET GEOGRAPHY * LEVEL OF INNOVATION

			Level of innovation			Total
			*	i	I	
Market geography	**Internal to enterprise**	Count	2	12	0	14
		% within *Market geography*	14.3%	85.7%	0.0%	100%
		% within *Level of innovation*	1.2%	2.4%	0.0%	1.9%
		% of Total	0.3%	1.7%	0.0%	1.9%
	Regional market (local region of own country)	Count	27	63	7	97
		% within *Market geography*	27.8%	64.9%	7.2%	100%
		% within *Level of innovation*	16.1%	12.5%	14.6%	13.5%
		% of Total	3.8%	8.8%	1.0%	13.5%
	Domestic market (rest of own country)	Count	72	216	23	311
		% within *Market geography*	23.2%	69.5%	7.4%	100%
		% within *Level of innovation*	42.9%	42.9%	47.9%	43.2%
		% of Total	10.0%	30.0%	3.2%	43.2%
	Export market	Count	63	171	12	246
		% within *Market geography*	25.6%	69.5%	4.9%	100%
		% within *Level of innovation*	37.5%	33.9%	25.0%	34.2%
		% of Total	8.8%	23.8%	1.7%	34.2%
	No information	Count	4	42	6	52
		% within *Market geography*	7.7%	80.8%	11.5%	100%
		% within *Level of innovation*	2.4%	8.3%	12.5%	7.2%
		% of Total	0.6%	5.8%	0.8%	7.2%
	Total	Count	168	504	48	720
		% within *Market geography*	23.3%	70.0%	6.7%	100%
		% within *Level of innovation*	100%	100%	100%	100%
		% of Total	23.3%	70.0%	6.7%	100%

Most firms (43.2%) indicated that their domestic market (in their own country) is their enterprise's largest market. These grouping also had the largest number of firms with high levels of innovation (**I** = 47.9%). The second largest grouping of firms with high levels of innovation (I = 25%) were those for whom the export market was their largest market, while the grouping that indicated their largest market as internal to the enterprise had the lowest innovation across all levels (***** = 1.2%; **i** = 2.4% and **I** = 0%, respectively).

5.2. Technology source, collaboration and linkage type of business networks

The main objective of this research was to find how the characteristics of a firm's business network contribute to its levels of innovation. This section describes each of the sub-characteristics of business networks as found from the results of the different statistical tests run on the responses of firms to the relevant questions (as described in **Section 4**).

5.2.1. Source of technology for the enterprise

The major sources of technology considered in this research were produced internally, bought from multinational corporations (MNC's) or bought from public sector organisations. Where technology was bought from other MNC's, the firm could buy it from branches of its own MNC (if it belonged to an MNC), or buy from other MNC firms. If technology was acquired from other MNC's, firms could also acquire from MNC's with which they were not formally connected.

Analysis of the statistical tests on these responses of the firms pointed to the fact that there was a significant association between the variables of technology source (independent variable 1) and level of innovation (dependent variable). These statistical tests and their results are presented and discussed in sections 5.2.1.1 and 5.2.1.2 below.

5.2.1.1. Contingency table analysis for use of technology source (Independent variable 1)

In order to find out the percentage of firms that use a specific source of technology and their level of innovation, a crosstabulation was prepared between source of technology

and level of innovation (being high, medium or low). A crosstabulation is a joint frequency distribution of cases based on two or more categorical variables (Michael, 2001). Displaying a distribution of cases by their values on two or more variables is known as contingency table analysis and is one of the more commonly used analytic methods in the social sciences.

This data was gathered from Question 5 in the questionnaire. It is presented in **Table 5.2.1.1** .

TABLE 5.2.1.1

CROSSTABULATION SOURCE OF TECHNOLOGY * LEVEL OF INNOVATION

			Level of Innovation			Total
			*	i	I	
TECHNOLOGY SOURCE	No info	Count	10	72	12	94
		% within Technology source	10.6%	76.6%	12.8%	100%
		% within Innovation Level	6.0%	14.3%	25.0%	13.1%
		% of Total	1.4%	10.0%	1.7%	13.1%
	Produce technological inputs in-house	Count	95	257	23	375
		% within Technology source	25.3%	68.5%	6.1%	100%
		% within Innovation Level	56.5%	51.0%	47.9%	52.1%
		% of Total	13.2%	35.7%	3.2%	52.1%
	Buy from other branches of MNC	Count	20	60	3	83
		% within Technology source	24.1%	72.3%	3.6%	100%
		% within Innovation Level	11.9%	11.9%	6.3%	11.5%
		% of Total	2.8%	8.3%	0.4%	11.5%
	Buy from non-MNC firms	Count	23	40	4	67
		% within Technology source	34.3%	59.7%	6.0%	100%
		% within Innovation Level	13.7%	7.9%	8.3%	9.3%
		% of Total	3.2%	5.6%	0.6%	9.3%
	Buy from MNCs with no formal connection	Count	15	63	3	81
		% within Technology source	18.5%	77.8%	3.7%	100%
		% within Innovation Level	8.9%	12.5%	6.3%	11.3%
		% of Total	2.1%	8.8%	0.4%	11.3%
	Buy from public-sector organisations	Count	5	12	3	20
		% within Technology source	25.0%	60.0%	15.0%	100%
		% within Innovation Level	3.0%	2.4%	6.3%	2.8%
		% of Total	0.7%	1.7%	0.4%	2.8%
TOTAL		Count	168	504	48	720
		% within Technology source	23.3%	70.0%	6.7%	100%
		% within Innovation Level	100%	100%	100%	100%
		% of Total	23.3%	70.0%	6.7%	100%

The crosstabulation indicated that while most of the firms (52.1%) produced their technological inputs in-house, this yielded a relatively low level of innovation (***** = 56.5%). However, overall, this group of firms also had the highest number of high innovators (**I** = 47.9%), followed by firms who buy most of their technology inputs from other branches of their own MNC (**I** = 11.5%) and firms who buy technology from MNC's with which they are not formally connected (**I** = 9.3%). The lowest levels of innovation were found in firms that bought most of their technological inputs from public-sector organisations such as research institutes and universities.

5.2.1.2. Test for significance in use of technology source (Independent variable 1)

The joint frequency distribution was analysed with the chi-square statistic to determine whether the variables were statistically independent or if they were associated (Michael, 2001). Chi-square tests for independence are one of the major statistical techniques to explore relationships among variables (Pallant, 2011). The following assumptions are made when using the chi-square test (Albright, Winston & Zappe, 2009, p.438):

- The sample must be randomly selected from the population;
- The sample size, *n*, must be large enough so that the expected count in each cell is greater than or equal to 5; and
- The observations are always assumed to be independent of each other.

The chi-square test for independence between source of technology and level of innovation is presented in **Table 5.2.1.2** below.

TABLE 5.2.1.2

CHI-SQUARE TEST FOR INDEPENDENCE

Chi-Square Tests Technology source * Level of innovation

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	23.982[a]	10	0.008
Likelihood Ratio	24.049	10	0.007
N of Valid Cases	720		

a. 3 cells (16.7%) have expected count less than 5. The minimum expected count is 1.33.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	0.183	0.008
	Cramer's V	0.129	0.008
N of Valid Cases		720	

The Pearson Chi-Square test indicated a significant association between technology source and level of innovation, $X^2(10, n = 720) = 23.982$, $p = .008$, Cramer's $V = .13$.

5.2.2. Collaboration type and geographical location for business networks of firms

In order to innovate, firms could actively collaborate with other organisations. These organisations could be:

i. Local: Within the own region or country of the firm
ii. Global: Outside the borders of the firm's country of residence, across a number of continents and geographical regions
iii. Firm actors: Collaborators could form part of the firm's existing supply chain, being clients, suppliers or even competitors

iv. Non-firm actors: Collaborators could be organisations external to the firm's supply chain, being consultancy companies, governments and local or foreign universities, research institutions or laboratoriums.

As described in Section 4, these variables were combined to better understand their interaction and the impact on level of innovation. Accordingly, the following variables were operationalized as follows:

- Variable x2a : Local firm actors
  Variable x2b : Local non-firm actors
- Variable x3a : Global firm actors
  Variable x3b : Global non-firm actors

For the purposes of brevity and to conform to non-parametric test requirements, the count scales used for the original operationalization of these variables were compacted to dichotomous indicators (0 = No; 1 = Yes) and crosstabulated with level of innovation (*, i or I).

Analysis of the statistical tests on these responses of the firms pointed to the fact that more firms were looking for local partners to collaborate on developing innovation (62.8% partnered with firm actors and 44.4% with non-firm actors). However, there were no significant level of association between any of the independent variables and the level of innovation. The following sections 5.2.2.1 and 5.2.2.2 describe the results and findings in detail.

5.2.2.1. Contingency table analysis for collaboration geography and type (Independent variables 2 and 3)

In order to review the percentage of firms that used a specific collaboration type (local/ global or firm/ non-firm) and their level of innovation, a crosstabulation was prepared between source of technology and level of innovation. This data was gathered from Question 7 in the questionnaire and is presented in **Tables 5.2.2.1a** and **b** below.

TABLE 5.2.2.1a

CROSSTABULATION LOCAL COLLABORATION TYPES * LEVEL OF INNOVATION

CROSSTABULATION LOCAL FIRM ACTORS * LEVEL OF INNOVATION

			Level of innovation			Total
			*	i	I	
Firm actors: Local (2a)	**No**	Count	57	193	18	268
		% within *Firm actors: Local*	21.3%	72.0%	6.7%	100%
		% within *Level of innovation*	33.9%	38.3%	37.5%	37.2%
		% of Total	7.9%	26.8%	2.5%	37.2%
	Yes	Count	111	311	30	452
		% within *Firm actors: Local*	24.6%	68.8%	6.6%	100%
		% within *Level of innovation*	66.1%	61.7%	62.5%	62.8%
		% of Total	15.4%	43.2%	4.2%	62.8%
Total		Count	168	504	48	720
		% within *Firm actors: Local*	23.3%	70.0%	6.7%	100%
		% within *Level of innovation*	100%	100%	100%	100%
		% of Total	23.3%	70.0%	6.7%	100%

CROSSTABULATION LOCAL NON-FIRM ACTORS * LEVEL OF INNOVATION

			Level of innovation			Total
			*	i	I	
Non-firm actors: Local (2b)	**No**	Count	99	270	31	400
		% within *Non-firm actors: Local*	24.8%	67.5%	7.8%	100%
		% within *Level of innovation*	58.9%	53.6%	64.6%	55.6%
		% of Total	13.8%	37.5%	4.3%	55.6%
	Yes	Count	69	234	17	320
		% within *Non-firm actors: Local*	21.6%	73.1%	5.3%	100%
		% within *Level of innovation*	41.1%	46.4%	35.4%	44.4%
		% of Total	9.6%	32.5%	2.4%	44.4%
Total		Count	168	504	48	720
		% within *Non-firm actors: Local*	23.3%	70.0%	6.7%	100%
		% within *Level of innovation*	100%	100%	100%	100%
		% of Total	23.3%	70.0%	6.7%	100%

TABLE 5.2.2.1b

CROSSTABULATION GLOBAL COLLABORATION TYPES * LEVEL OF INNOVATION

CROSSTABULATION GLOBAL FIRM ACTORS * LEVEL OF INNOVATION

			Level of innovation			Total
			*	i	I	
Firm actors: Global (3a)	**No**	Count	100	297	31	428
		% within *Firm actors: Global*	23.4%	69.4%	7.2%	100%
		% within *Level of innovation*	59.5%	58.9%	64.6%	59.4%
		% of Total	13.9%	41.3%	4.3%	59.4%
	Yes	Count	68	207	17	292
		% within *Firm actors: Global*	23.3%	70.9%	5.8%	100%
		% within *Level of innovation*	40.5%	41.1%	35.4%	40.6%
		% of Total	9.4%	28.8%	2.4%	40.6%
Total		Count	168	504	48	720
		% within *Firm actors: Global*	23.3%	70.0%	6.7%	100%
		% within *Level of innovation*	100%	100%	100%	100%
		% of Total	23.3%	70.0%	6.7%	100%

CROSSTABULATION GLOBAL NON-FIRM ACTORS * LEVEL OF INNOVATION

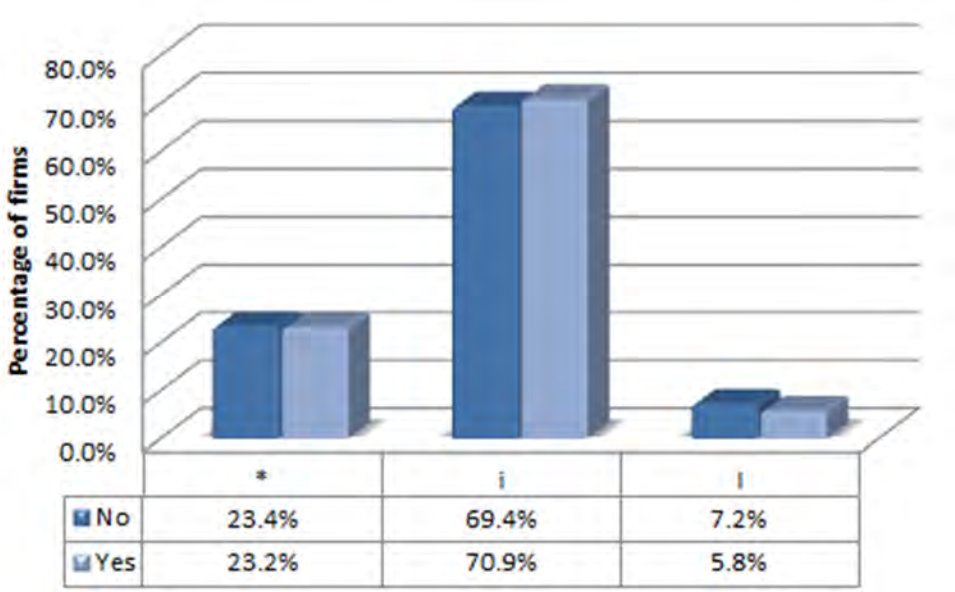
			Level of innovation			Total
			*	i	I	
Non-firm: Global (3b)	**No**	Count	129	380	38	547
		% within *Non-firm: Global*	23.6%	69.5%	6.9%	100%
		% within *Level of innovation*	76.8%	75.4%	79.2%	76.0%
		% of Total	17.9%	52.8%	5.3%	76.0%
	Yes	Count	39	124	10	173
		% within *Non-firm: Global*	22.5%	71.7%	5.8%	100%
		% within *Level of innovation*	23.2%	24.6%	20.8%	24.0%
		% of Total	5.4%	17.2%	1.4%	24.0%
Total		Count	168	504	48	720
		% within *Non-firm: Global*	23.3%	70.0%	6.7%	100%
		% within *Level of innovation*	100%	100%	100%	100%
		% of Total	23.3%	70.0%	6.7%	100%

The majority of firms (62.8%) collaborated with other local firm actors (regional or domestic) in order to develop innovation. Interestingly, this yielded the same number of firms with high levels of innovation (I = 6.6%) as those that did not collaborate (I = 6.7%). A number of firms (44.4%) extended their collaboration efforts to local non-firm actors like consulting companies, government, universities and research institutions to gain access to innovation inputs.

Firms that collaborated with global firm actors in order to develop innovation had roughly the same distribution of levels of innovation within the sub-population as those that did not. This is depicted in **Diagram 5.2.2.1**.

DIAGRAM 5.2.2.1

HISTOGRAM OF FIRMS COLLABORATING WITH GLOBAL FIRM ACTORS



Only 24% of firms extended their collaboration efforts to also include global non-firm actors.

5.2.2.2. Test for significance in use of collaboration geography and type (Independent variables 2 and 3)

The chi-square test for independence between collaboration types and level of innovation is presented in **Table 5.2.2.2**.

TABLE 5.2.2.2

CHI-SQUARE TEST FOR INDEPENDENCE

Chi-Square Tests Local firm actors (2a) * Level of innovation

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.029a	2	0.598
Likelihood Ratio	1.038	2	0.595
N of Valid Cases	720		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 17.87.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	0.038	0.598
	Cramer's V	0.038	0.598
N of Valid Cases		720	

Chi-Square Tests Global firm actors (3a) * Level of innovation

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.582a	2	0.748
Likelihood Ratio	0.59	2	0.745
N of Valid Cases	720		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 19.47.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	0.028	0.748
	Cramer's V	0.028	0.748
N of Valid Cases		720	

Chi-Square Tests Local non-firm actors (2b) * Level of innovation

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.162a	2	0.206
Likelihood Ratio	3.196	2	0.202
N of Valid Cases	720		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 21.33.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	0.066	0.206
	Cramer's V	0.066	0.206
N of Valid Cases		720	

Chi-Square Tests Global non-firm actors (3b) * Level of innovation

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.421a	2	0.81
Likelihood Ratio	0.429	2	0.807
N of Valid Cases	720		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 11.53.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	0.024	0.81
	Cramer's V	0.024	0.81
N of Valid Cases		720	

For each of the tests, the outcome was as follows:

i. Chi-square test IV2a

The Pearson Chi-Square test did not indicate a significant association between local firm actors and level of innovation, $X^2(2, n = 720) = 1.029$, $p = .598$, Cramer's $V = .04$.

ii. Chi-square test IV2b

The Pearson Chi-Square test did not indicate a significant association between local non-firm actors and level of innovation, $X^2(2, n = 720) = 3.162$, $p = .206$, Cramer's $V = .07$.

iii. Chi-square test IV3a

The Pearson Chi-Square test did not indicate a significant association between global firm actors and level of innovation, $X^2(2, n = 720) = .582$, $p = .748$, Cramer's $V = .03$.

iv. Chi-square test IV3b

The Pearson Chi-Square test did not indicate a significant association between global non-firm actors and level of innovation, $X^2(2, n = 720) = .421$, $p = .81$, Cramer's $V = .02$.

5.2.3. Linkage type

Firms may develop formal or informal linkages with other organisations, which may assist in gaining access to, developing and transferring innovation. The questionnaire specifically directed respondents to indicate the existence of linkages with foreign organisations. While formal linkages presuppose the existence of a formalised agreement, informal linkages would imply that no written contract or financial obligation existed.

As described in Section 4, these variables were combined to better understand their interaction and the impact on level of innovation. Accordingly, the following variables were operationalized as follows:

- Variable x4a : Formal linkages with firm actors
  Variable x4b : Formal linkages with non-firm actors
- Variable x5a : Informal linkages with firm actors
  Variable x5b : Informal linkages with non-firm actors
- Variable x6a : No linkages with firm actors
  Variable x6b : No linkages with non-firm actors

For the purposes of brevity and to conform to non-parametric test requirements, the scales used for the original operationalization of these variables were compacted to dichotomous indicators (0 = No; 1 = Yes) and crosstabulated with level of innovation (*, i or I).

Analysis of the statistical tests on these responses of the firms pointed to the fact that there were significant associations between formal linkages with both firm and non-firm actors (Variables 4a and 4b) as well as a significant association between the level of innovation of firms that did not form any linkages with either firm or non-firm actors (Variables 6a and 6b). The following sections 5.2.3.1 and 5.2.3.2 describe the results and findings in detail.

5.2.3.1. Contingency table analysis for linkage type (Independent variables 4, 5 and 6)

In order to review the percentage of firms that use specific linkage types and their level of innovation, a crosstabulation was prepared between source of technology and level of innovation. This data was gathered from Question 8 in the questionnaire and is presented in **Tables 5.2.3.1a, b** and **c** below.

TABLE 5.2.3.1a

CROSSTABULATION FORMAL LINKAGES * LEVEL OF INNOVATION

CROSSTABULATION FORMAL LINKAGES with FIRM ACTORS * LEVEL OF INNOVATION

			Level of innovation			Total
			*	i	I	
Formal linkages with firm actors (4a)	**No**	Count	48	186	24	258
		% within *Formal linkages: Firm actors*	18.6%	72.1%	9.3%	100%
		% within *Level of innovation*	28.6%	36.9%	50.0%	35.8%
		% of Total	6.7%	25.8%	3.3%	35.8%
	Yes	Count	120	318	24	462
		% within *Formal linkages: Firm actors*	26.0%	68.8%	5.2%	100%
		% within *Level of innovation*	71.4%	63.1%	50.0%	64.2%
		% of Total	16.7%	44.2%	3.3%	64.2%
Total		Count	168	504	48	720
		% within *Formal linkages: Firm actors*	23.3%	70.0%	6.7%	100%
		% within *Level of innovation*	100%	100%	100%	100%
		% of Total	23.3%	70.0%	6.7%	100%

CROSSTABULATION FORMAL LINKAGES with NON-FIRM ACTORS * LEVEL OF INNOVATION

			Level of innovation			Total
			*	i	I	
Formal linkages with non-firm actors (4b)	**No**	Count	104	298	37	439
		% within *Formal linkages: Non-firm actors*	23.7%	67.9%	8.4%	100%
		% within *Level of innovation*	61.9%	59.1%	77.1%	61.0%
		% of Total	14.4%	41.4%	5.1%	61.0%
	Yes	Count	64	206	11	281
		% within *Formal linkages: Non-firm actors*	22.8%	73.3%	3.9%	100%
		% within *Level of innovation*	38.1%	40.9%	22.9%	39.0%
		% of Total	8.9%	28.6%	1.5%	39.0%
Total		Count	168	504	48	720
		% within *Formal linkages: Non-firm actors*	23.3%	70.0%	6.7%	100%
		% within *Level of innovation*	100%	100%	100%	100%
		% of Total	23.3%	70.0%	6.7%	100%

The majority of firms (64.2%) indicated that they had developed formal linkages with firm actors, while 39.0% indicated that they also had formal linkages with non-firm actors. Formal linkages with firm actors had simultaneous high levels of innovation, with 50% of all firms with a high level of innovation falling in this category.

TABLE 5.2.3.1b

CROSSTABULATION INFORMAL LINKAGES * LEVEL OF INNOVATION

CROSSTABULATION INFORMAL LINKAGES with FIRM ACTORS * LEVEL OF INNOVATION

			Level of innovation			Total
			*	i	I	
Informal linkages with firm actors (5a)	**No**	Count	126	397	31	554
		% within *Informal linkages: Firm actors*	22.7%	71.7%	5.6%	100%
		% within *Level of innovation*	75.0%	78.8%	64.6%	76.9%
		% of Total	17.5%	55.1%	4.3%	76.9%
	Yes	Count	42	107	17	166
		% within *Informal linkages: Firm actors*	25.3%	64.5%	10.2%	100%
		% within *Level of innovation*	25.0%	21.2%	35.4%	23.1%
		% of Total	5.8%	14.9%	2.4%	23.1%
Total		Count	168	504	48	720
		% within *Informal linkages: Firm actors*	23.3%	70.0%	6.7%	100%
		% within *Level of innovation*	100%	100%	100%	100%
		% of Total	23.3%	70.0%	6.7%	100%

CROSSTABULATION INFORMAL LINKAGES with NON-FIRM ACTORS * LEVEL OF INNOVATION

			Level of innovation			Total
			*	i	I	
Informal linkages with non-firm actors	**No**	Count	146	446	41	633
		% within *Informal linkages: Non-firm actors*	23.1%	70.5%	6.5%	100%
		% within *Level of innovation*	86.9%	88.5%	85.4%	87.9%
		% of Total	20.3%	61.9%	5.7%	87.9%
	Yes	Count	22	58	7	87
		% within *Informal linkages: Non-firm actors*	25.3%	66.7%	8.0%	100%
		% within *Level of innovation*	13.1%	11.5%	14.6%	12.1%
		% of Total	3.1%	8.1%	1.0%	12.1%
Total		Count	168	504	48	720
		% within *Informal linkages: Non-firm actors*	23.3%	70.0%	6.7%	100%
		% within *Level of innovation*	100%	100%	100%	100%
		% of Total	23.3%	70.0%	6.7%	100%

Fewer firms indicated informal linkages with either firm actors (23.1%) or non-firm actors (12.1%). Only 10.2% of firms with high levels of innovation reported informal linkages with firm actors, while the highest percentages of innovation across all levels were found in firms that indicated no informal linkages with non-firm actors.

TABLE 5.2.3.1c

CROSSTABULATION NO LINKAGES * LEVEL OF INNOVATION

CROSSTABULATION NO LINKAGES with FIRM ACTORS * LEVEL OF INNOVATION

			Level of innovation			Total
			*	i	I	
No linkages with firm actors (6a)	**No**	Count	55	239	22	316
		% within *No linkages: Firm actors*	17.4%	75.6%	7.0%	100%
		% within *Level of innovation*	32.7%	47.4%	45.8%	43.9%
		% of Total	7.6%	33.2%	3.1%	43.9%
	Yes	Count	113	265	26	404
		% within *No linkages: Firm actors*	28.0%	65.6%	6.4%	100%
		% within *Level of innovation*	67.3%	52.6%	54.2%	56.1%
		% of Total	15.7%	36.8%	3.6%	56.1%
Total		Count	168	504	48	720
		% within *No linkages: Firm actors*	23.3%	70.0%	6.7%	100%
		% within *Level of innovation*	100%	100%	100%	100%
		% of Total	23.3%	70.0%	6.7%	100%

CROSSTABULATION NO LINKAGES with NON-FIRM ACTORS * LEVEL OF INNOVATION

			Level of innovation			Total
			*	i	I	
No linkages with non-firm actors (6b)	**No**	Count	43	183	18	244
		% within *No linkages: Non-firm actors*	17.6%	75.0%	7.4%	100%
		% within *Level of innovation*	25.6%	36.3%	37.5%	33.9%
		% of Total	6.0%	25.4%	2.5%	33.9%
	Yes	Count	125	321	30	476
		% within *No linkages: Non-firm actors*	26.3%	67.4%	6.3%	100%
		% within *Level of innovation*	74.4%	63.7%	62.5%	66.1%
		% of Total	17.4%	44.6%	4.2%	66.1%
Total		Count	168	504	48	720
		% within *No linkages: Non-firm actors*	23.3%	70.0%	6.7%	100%
		% within *Level of innovation*	100%	100%	100%	100%
		% of Total	23.3%	70.0%	6.7%	100%

Firms who indicated no linkages with either firm or non-firm actors presented high percentages of innovation across all levels of innovation. The highest percentages of innovation across all levels were found in firms that indicated no linkages with non-firm actors.

5.2.3.2. Test for significance in linkage type (Independent variables 4, 5 and 6)

TABLE 5.2.3.2

CHI-SQUARE TEST FOR INDEPENDENCE

Chi-Square Test Formal linkages with firm actors (4a) * Level of innovation

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.294[a]	2	0.016
Likelihood Ratio	8.257	2	0.016
N of Valid Cases	720		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 17.20.

Symmetric measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	0.107	0.016
	Cramer's V	0.107	0.016
N of Valid Cases		720	

Chi-Square Test Formal linkages with non-firm actors (4b) * Level of innovation

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.018[a]	2	0.049
Likelihood Ratio	6.417	2	0.04
N of Valid Cases	720		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 18.73.

Symmetric measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	0.091	0.049
	Cramer's V	0.091	0.049
N of Valid Cases		720	

Chi-Square Test Informal linkages with firm actors (5a) * Level of innovation

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.439[a]	2	0.066
Likelihood Ratio	5.054	2	0.08
N of Valid Cases	720		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 11.07.

Symmetric measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	0.087	0.066
	Cramer's V	0.087	0.066
N of Valid Cases		720	

Chi-Square Test Informal linkages with non-firm actors (5b) * Level of innovation

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.601[a]	2	0.74
Likelihood Ratio	0.585	2	0.747
N of Valid Cases	720		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.80.

Symmetric measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	0.029	0.74
	Cramer's V	0.029	0.74
N of Valid Cases		720	

Chi-Square Test No linkages with firm actors (6a) * Level of innovation

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.109[a]	2	0.004
Likelihood Ratio	11.335	2	0.003
N of Valid Cases	720		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 21.07.

Symmetric measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	0.124	0.004
	Cramer's V	0.124	0.004
N of Valid Cases		720	

Chi-Square Test No linkages with non-firm actors (6b) * Level of innovation

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.755[a]	2	0.034
Likelihood Ratio	6.986	2	0.03
N of Valid Cases	720		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 16.27.

Symmetric measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	0.097	0.034
	Cramer's V	0.097	0.034
N of Valid Cases		720	

The chi-square test for independence between collaboration types and level of innovation is presented in **Table 5.2.3.2** above.

For each of the tests, the outcome was as follows:

i. Chi-square test IV4a

The Pearson Chi-Square test indicated a significant association ($p < .05$) between formal linkages with firm actors and level of innovation, $X^2(2, n = 720) = 8.294$, $p = .016$, Cramer's $V = .11$.

ii. Chi-square test IV4b

The Pearson Chi-Square test indicated a significant association ($p < .05$) between formal linkages with non-firm actors and level of innovation, $X^2(2, n = 720) = 6.018$, $p = .049$, Cramer's $V = .05$.

iii. Chi-square test IV5a

The Pearson Chi-Square test indicated a marginally significant association ($p < .1$) between informal linkages with firm actors and level of innovation, $X^2(2, n = 720) = 5.439$, $p = .066$, Cramer's $V = .09$.

iv. Chi-square test IV5b

The Pearson Chi-Square test did not indicate a significant association between informal linkages with non-firm actors and level of innovation, $X^2(2, n = 720) = .601$, $p = .74$, Cramer's $V = .03$.

v. Chi-square test IV6a

The Pearson Chi-Square test indicated a highly significant association ($p < .01$) between no linkages with firm actors and level of innovation, $X^2(2, n = 720) = 11.109$, $p = .004$, Cramer's $V = .12$.

vi. Chi-square test IV6b

The Pearson Chi-Square test indicated a significant association ($p < .05$) between no linkages with non-firm actors and level of innovation, $X^2(2, n = 720) = 6.755$, $p = .034$, Cramer's $V = .097$.

5.3 The relationship between innovation and business networks

The characteristics and types of business networks explained above provide an overview of the basic patterns among firms with different levels of innovation. This analysis was conducted on the individual characteristics of different elements of business networks and their link to level of innovation.

The main objective of this research was to find how the characteristics of a firm's business network contribute to its levels of innovation. Therefore, the assumption was that there may be interdependencies between the different elements of innovation and business networks when all these characteristics are combined. This was based on literature highlighting that the isolated consideration of firm characteristics is not enough to fully understand the impact on innovation practices; rather the interaction between these variables needs to be considered (Tidd, Bessant & Pavitt, 2005). It then becomes necessary to try and determine which characteristics are significant in explaining these relationships, as well as to what extent.

In order to answer these questions, a number of models were built to find the model:

- which best fitted the data; and
- which was superior in terms of predictability of the relationship between business networks and innovation level.

5.3.1. Obtaining the best model

In order to obtain the best model in terms of data fit and superior predictability, the analysis of the hierarchical models was reiterated to determine the best fit and superior

predictability. Various changes were made taking statistical best practice into consideration. In order to accurately describe the methodological approach, a summary of the process is presented below. Ultimately, the best model was chosen, and that is the one that will be described in detail in further sections.

Of the various models tested and analysed, the following are worth mentioning:

i. The completed hierarchical model following multiple regressions, with all control variables and independent variables included as possible predictor variables;

ii. The hierarchical model with grouped variables was sub-divided and dummy variables were included to further distill analysis and control for the effects of multicolllinearity;

iii. The refined model with high variance inflation factors (VIF's) was removed;

iv. The final model excluded the following variables: Brazil (Country) and Automotive (Industry) .

Table 5.3.1 presents a summary of some of the salient statistics of these models.

TABLE 5.3.1

SUMMARY OF COMPARATIVE STATISTICS BETWEEN FOUR MODELS

Model	R^2 value	Adj R^2 value	F	Sig.
1. Complete hierarchical model	0.103	0.084	5.418	.000*
2. Grouped variables sub-divided and dummy variables and baselines included	0.140	0.107	4.176	.000*
3. Variables with high VIF removed	0.130	0.102	4.539	.000*
4. With Brazil and Automotive excluded	0.138	0.109	4.783	.000*

* $p < 0.05$

The **second model** that did not use the composite variables but rather uses the sub-variables for each item was found to be superior in terms of data fit and predictability. This model was then further refined to counter any possible extraneous variability effects, yielding the **third model**.

After controlling for variability effects, high levels of multicollinearity remained, especially between the *Country* and *Industry* control variables. When faced with multicollinearity, the researcher is advised to increase the sample size or investigate different ways of dealing with the variables, including creating compound variables and using factor analysis (Williams, 2011). The improvement in data fit between Model 1 (original model with all variables included) and Model 2 (breaking down control variables to dummy variables and baseline variables) showed that compounding variables would not improve the model. Factor analysis was not an option as it did not fit the hypotheses.

When these options do not yield optimal results, it is suggested that the variable(s) responsible for the multicollinearity be excluded from the model (Williams, 2011). The variables for *Country* and *Industry* could not be omitted entirely due to concern for specification error, therefore various versions of the model was run excluding one of the dummy variables for *Country* and one of the dummy variables for *Industry*. Omitting the dummy variables Brazil (Country) and Automotive (Industry) yielded the best results (n = 651). This was supported by the literature which detailed the automotive industry as a more hierarchical sector than agro-processing and ICT, therefore indicating different ways of acquiring and developing innovation. Therefore the chosen model of this research was the **fourth model** and the sub-sections below detail the same.

5.3.2. Overall summary of the model

Multiple regression forms part of a family of techniques that can be used to explore the relationship between one continuous dependent variable (level of innovation) and several (usually continuous) independent variables or predictors (Albright, Winston & Zappe, 2009, p.596). Multiple regression is based on correlation (see sections 5.1 and 5.2 above), but allows a more sophisticated exploration of the interrelationship among a set of variables (Pallant, 2011, p.148).

5.3.2.1. Defining the blocks of variables

In hierarchical regression, the independent variables are entered into the equation in the order specified by the researcher. In this case, the variables were entered in steps (or blocks). A block of control variables was entered first, which meant that each independent variable would be assessed in terms of what it adds to the prediction of the dependent variable after the previous variables have been controlled for (Pallant, 2011, p.149).

Independent variables were added based on their association with a specific hypothesis. As a final step, all independent variables were entered in the final block. The resulting output was adapted based on statistical best practice (as discussed in section 5.3 above) and the final output is used for discussion purposes below.

Table 5.3.2.1 provides a summary of the regression variables and blocks of entry.

TABLE 5.3.2.1

REGRESSION VARIABLE SUMMARY

BLOCK		VARIABLE	VARIABLE TYPE	DESCRIPTION	QUESTION	IN FINAL MODEL?
Dependent variable		**Innovation Score**	Continuous (bounded 0.00 - 1.00)	Level of innovation experienced by the firm from 2006 - 2008 Operationalised on a continuous scale (detailed in Section 4)	6	Yes
Control		**Country**	Categorical	Country of orgin headquarters of the firm		No
		Brazil***	Dummy			No - removed due to multicollinearity
		China*	Baseline			Baseline
		India	Dummy			Yes
		South Africa	Dummy			Yes
		Industry	Categorical	Industry for which the firm produces its main product (goods or services)	1.1	No
		Agro-processing	Dummy			Yes
		Automotive***	Dummy			No - removed due to multicollinearity
		ICT*	Baseline			Baseline
		Company structure	Categorical	Relationship in terms of headquarters and subsidiaries	2	
		Standalone	Dummy			Yes
		Subsidiary of MNC*	Baseline			Baseline
		HQ of MNC	Dummy			Yes
		Company size	Continuous	Number of full-time emplyees at firm	3.1	
		Size median	Continuous	Aggregate scale of median number of employees per company		Yes
		Less than 10 FTE	Dummy			No
		10 - 49 employees	Dummy			No
		50 - 249 employees	Dummy			No
		250 - 999 employees	Dummy			No
		1000 or more employees	Dummy			No
		Sales	Categorical	Does the firm have a significant share of sales activity abroad	3.2	Yes
		% sales from exports	Continuous	Percentage (%) of total sales derived from export	3.2.1	Yes
		Geographical market	Categorical	The firm's largets market in geographical terms	4.1	
		Internal market	Dummy			Yes
		Regional market*	Baseline			Baseline
		Domestic market	Dummy			Yes
		Export market	Dummy			Yes
Independent variables	x1	**Technology source**	Categorical	The most important source of technology for the firm	5	Yes
		Collaboration type		Who did the firm actively collaborate with to develop innovation and in which geographical location	7	
	x2a	Firm actors: Local	Count			Yes
	x2b	Non-firm actors: Local	Count			Yes
	x2c	Firm actors: Global	Count			Yes
	x2d	Non-firm actors: Global	Count			Yes
		Linkage type		Has the enterprise developed formal/ informal linkages with foreign organisations to develop innovation	8	
	x3a	Firm actors: Formal	Count			Yes
	x3b	Non-firm actors: Formal	Count			Yes
	x3c	Firm actors: Informal	Count			Yes
	x3d	Non-firm actors: Informal	Count			Yes
	x3e	Firm actors: None**	Count			No - removed due to VIF
	x3f	Non-firm actors: None	Count			Yes

* Baseline variable: China, ICT, Subsidiary of MNC, Regional market
** Removed from final model due to high variance inflation factor (VIF): Firm actors: No linkage
*** Removed from final model due to multicollinearity: Brazil, Automotive

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5.3.2.2. Checking the assumptions

Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity.

Table 5.3.2.2a shows the details of the various steps of the hierarchical multiple regression. This table provides an overview of the descriptive statistics for each variable as well as the correlations between variables.

While it is required that variables show at least some relationship (preferably above .3), it is recommended that variables with a bivariate correlation of .7 or higher not be included in the same analysis (Pallant, 2011, p.158).

Variables to be omitted were identified by considering the tolerance and variance inflation factor (VIF):

- Variables with a tolerance value of less than .10 were omitted as this indicates that the multiple correlation with other variables are very high, suggesting the possibility of multicollinearity;
- Variables with a VIF values higher than 10 were omitted for the same reason.

TABLE 5.3.2.2a

DESCRIPTIVE STATISTICS AND CORRELATION MATRIX

		Mean	Std. Deviation	1	2	3	4	5	6	7	8	9	10	11
Pearson Correlation	1 Innovation Score	0.2102407	0.2133997	1										
	2 India	0.5	0.5	**-0.197**	1									
	3 South Africa	0.13	0.335	**0.322**	**-0.383**	1								
	4 Agro-processing	0.11	0.312	**0.306**	**-0.348**	**0.909**	1							
	5 Standalone	0.48	0.5	0.049	0.069	**0.079**	0.058	1						
	6 HQ of MNC	0.18	0.383	**-0.122**	-0.062	**-0.179**	**-0.163**	**-0.448**	1					
	7 Company size (median)	148.25	279.588	0.044	**-0.45**	**0.151**	**0.15**	**-0.179**	**0.119**	1				
	8 Sales	1.4	0.572	**-0.166**	**0.471**	**-0.303**	**-0.255**	0	**0.072**	**-0.097**	1			
	9 % sales from exports	23.28	34.634	**-0.097**	**0.3**	**-0.116**	**-0.093**	**-0.068**	**0.111**	**-0.11**	**0.7**	1		
	10 Internal market	0.02	0.145	-0.002	0.064	-0.057	-0.052	0.048	-0.041	-0.044	-0.03	-0.03	1	
	11 Domestic market	0.45	0.497	0.055	**-0.225**	-0.004	-0.006	**0.078**	0.011	**0.199**	**-0.41**	**-0.494**	**-0.133**	1
	12 Export market	0.38	0.485	**-0.111**	**0.406**	**-0.167**	**-0.129**	**-0.094**	0.036	**-0.163**	**0.729**	**0.699**	**-0.115**	**-0.696**
	13 Source of technology (x1)	1.63	1.268	-0.021	**0.219**	0.013	0.006	-0.031	**0.103**	**-0.085**	**0.315**	**0.307**	-0.048	**-0.081**
	14 Firm actors: Local collaboration (x2a)	1.56	1.519	0.01	**0.223**	-0.055	-0.052	-0.033	**0.107**	-0.025	**0.266**	**0.12**	-0.041	-0.048
	15 Non-firm actors: Local collaboration (x2b)	1.14	1.503	0.005	**0.293**	-0.021	-0.01	0.004	**0.09**	-0.025	**0.324**	**0.222**	0.028	**-0.138**
	16 Firm actors: Global collaboration (x2c)	1.76	2.941	0.012	**0.341**	**-0.078**	-0.063	**-0.222**	**0.108**	**-0.094**	**0.462**	**0.467**	-0.06	**-0.325**
	17 Non-firm: Global collaboration (x2d)	0.78	1.688	0.015	**0.283**	-0.013	-0.005	**-0.181**	**0.074**	-0.043	**0.368**	**0.407**	-0.019	**-0.264**
	18 Firm actors: Formal linkages (x3a)	1.37	1.142	**-0.141**	**0.392**	**-0.318**	**-0.3**	**-0.171**	**0.091**	**-0.132**	**0.447**	**0.35**	-0.011	**-0.167**
	19 Firm actors: Informal linkages (x3c)	0.31	0.602	**0.084**	**-0.067**	**0.227**	**0.22**	**0.074**	0.039	0.058	0.033	-0.022	-0.024	0.018
	20 Non-firm actors: Formal linkages (x3b)	0.84	1.133	**-0.074**	**0.459**	**-0.16**	**-0.15**	**-0.143**	0.049	**-0.123**	**0.457**	**0.41**	-0.026	**-0.287**
	21 Non-firm actors: Informal linkages (x3d)	0.19	0.555	0.023	-0.046	**0.177**	**0.167**	-0.001	**0.09**	**0.153**	**0.113**	**0.081**	0.008	-0.033
	22 Non-firm actors: No linkages (x3f)	1.73	1.359	-0.024	**-0.254**	**-0.176**	**-0.147**	**0.155**	-0.051	0.032	**-0.187**	**-0.286**	0.022	**0.294**

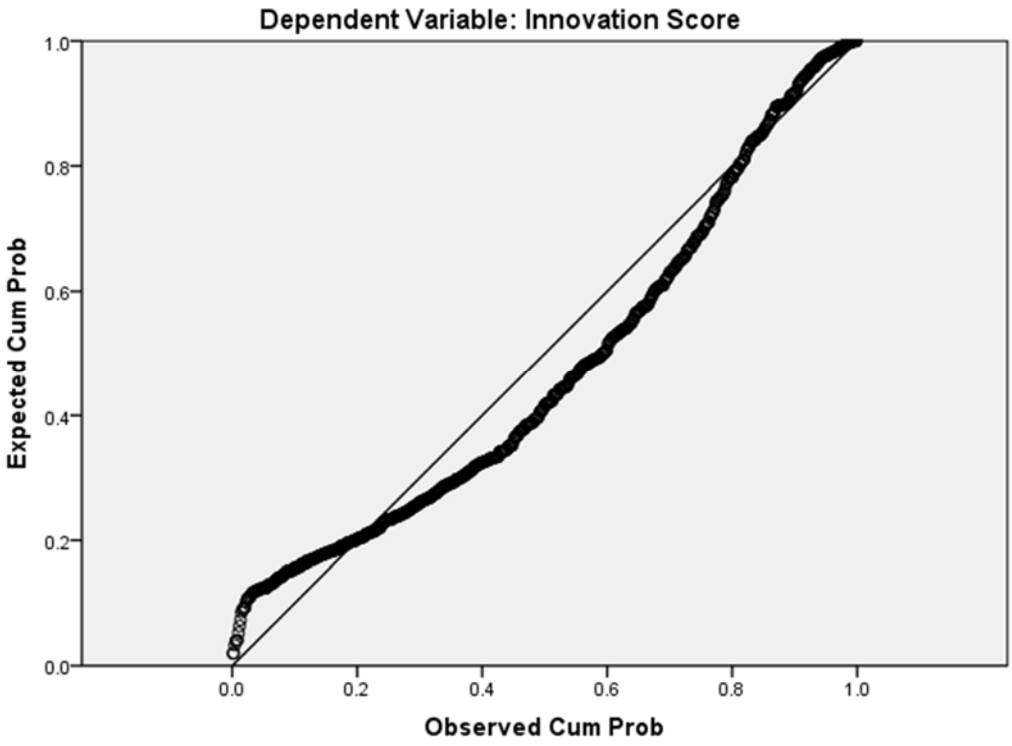
		12	13	14	15	16	17	18	19	20	21	22
12	Export market	1										
13	Source of technology (x1)	**0.22**	1									
14	Firm actors: Local collaboration (x2a)	**0.175**	**0.277**	1								
15	Non-firm actors: Local collaboration (x2b)	**0.254**	**0.296**	**0.684**	1							
16	Firm actors: Global collaboration (x2c)	**0.515**	**0.345**	**0.416**	**0.452**	1						
17	Non-firm: Global collaboration (x2d)	**0.387**	**0.311**	**0.283**	**0.387**	**0.705**	1					
18	Firm actors: Formal linkages (x3a)	**0.394**	**0.234**	**0.338**	**0.35**	**0.425**	**0.318**	1				
19	Firm actors: Informal linkages (x3c)	**-0.076**	**0.097**	**0.13**	**0.14**	0.01	0.018	**-0.247**	1			
20	Non-firm actors: Formal linkages (x3b)	**0.461**	**0.272**	**0.297**	**0.455**	**0.503**	**0.501**	**0.641**	**-0.08**	1		
21	Non-firm actors: Informal linkages (x3d)	0.008	**0.09**	**0.206**	**0.271**	**0.093**	**0.179**	-0.034	**0.447**	-0.038	1	
22	Non-firm actors: No linkages (x3f)	**-0.287**	**-0.17**	**-0.202**	**-0.375**	**-0.36**	**-0.37**	**-0.368**	-0.046	**-0.671**	**-0.261**	1

Correlations significant at 0.05 level are in bold

The baseline for *Country* is China, the baseline for *Industry* is ICT, the baseline *Company type* is Subsidiary of an MNC, the baseline for *Market type* is Regional market

DIAGRAM 5.3.2.2.

NORMAL PROBABILITY PLOT (P-P) OF THE REGRESSION STANDARDISED RESIDUAL



The normal probability plot (P-P) of the regression standardised residual (see **Diagram 5.3.2.2**) presented a reasonably straight diagonal line from bottom left to top right, suggesting no major deviations from normality.

TABLE 5.3.2.2b

RESIDUALS STATISTICS

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	0.070	0.497	0.210	0.079	651
Std. Predicted Value	-1.771	3.626	0.000	1	651
Standard Error of Predicted Value	0.020	0.089	0.036	0.010	651
Adjusted Predicted Value	0.051	0.497	0.210	0.080	651
Residual	-0.414	0.766	0.000	0.198	651
Std. Residual	-2.055	3.801	0.000	0.984	651
Stud. Residual	-2.200	3.839	0.000	1.001	651
Deleted Residual	-0.476	0.789	0.000	0.205	651
Stud. Deleted Residual	-2.207	3.882	0.000	1.004	651
Mahal. Distance	5.225	125.975	20.968	14.536	651
Cook's Distance	0.000	0.041	0.002	0.004	651
Centered Leverage Value	0.008	0.194	0.032	0.022	651

The maximum value for Cook's Distance from the residual statistics was .041, indicating that even though some outliers were present they did not unduly influence the results of the model as a whole.

5.3.2.3. Evaluating the model

The control variables were entered at Step 1, explaining 12.2% of the variance of the dependent variable (level of innovation) (R square = 0.122). The adjusted R square corrected value (taking the effect of sample size into consideration) brought the value down to 10.7% (Adjusted R square = 0.107).

After entry of the independent variables at Step 2 the total variance explained by the model as a whole was 10.9% (adjusted *R* square = 0.109), $F(21, 629) = 4.783$, $p < 0.001$.

TABLE 5.3.2.3

MODEL SUMMARY AND ANOVA

Model Summary (c)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.349a	0.122	0.107	0.201711	0.122	8.047	11	639	0
2	.371b	0.138	0.109	0.201444	0.016	1.169	10	629	0.309

a. Predictors: (Constant), Export, HQ of MNC, Internal, Size med, Agro-processing, Standalone, India, % sales from exports, Domestic, Sales, South Africa
b. Predictors: (Constant), Export, HQ of MNC, Internal, Size med, Agro-processing, Standalone, India, % sales from exports, Domestic, Sales, South Africa, Non-firm actors: Informal, Firm actors: Local, Technology source, Firm actors: Informal, Non-firm: Global, Non-frim actors: None, Firm actors: Formal, Non-firm actors: Local, Firm actors: Global, Non-firm actors: Formal
c. Dependent Variable: Innovation Score
d. The baseline for *Country* is China, the baseline for *Industry* is ICT, the baseline *Company type* is Subsidiary of an MNC, the baseline for *Market type* is Regional market

ANOVA (c)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.602	11	0.327	8.047	.000a
	Residual	25.999	639	0.041		
	Total	29.601	650			
2	Regression	4.076	21	0.194	4.783	.000b
	Residual	25.525	629	0.041		
	Total	29.601	650			

a. Predictors: (Constant), Export, HQ of MNC, Internal, Size med, Agro-processing, Standalone, India, % sales from exports, Domestic, Sales, South Africa
b. Predictors: (Constant), Export, HQ of MNC, Internal, Size med, Agro-processing, Standalone, India, % sales from exports, Domestic, Sales, South Africa, Non-firm actors: Informal, Firm actors: Local, Technology source, Firm actors: Informal, Non-firm: Global, Non-frim actors: None, Firm actors: Formal, Non-firm actors: Local, Firm actors: Global, Non-firm actors: Formal
c. Dependent Variable: Innovation Score
d. The baseline for Country is China, the baseline for Industry is ICT, the baseline Company type is Subsidiary of an MNC, the baseline for Market type is Regional market

The ANOVA table shows that the model as a whole (including both blocks of variables) was significant. The independent variables explained an additional 1.2% of the variance in level of innovation, after controlling for demographic variability, *R* squared change = 0.016, *F* change (11, 629) = 1.169, $p < .001$. The model is highly statistically significant.

5.3.2.4. Evaluating each of the independent variables

The final step was to determine which of the variables included in the model contributed to the prediction of the dependent variable.

A hierarchical multiple regression analysis was employed to predict *Level of Innovation*. On the first step, the control variables were entered into the model. Of these variables, India (*Country*) (negative association), South Africa (*Country*) and Headquarters of a MNC (*Company structure*) (negative association) were significantly correlated with *Level of Innovation*. This is shown in bold with asterisks in Table 5.3.2.4.

In the last step, all remaining predictor variables were entered simultaneously. Of these, only Firm actors: Global collaboration (*Collaboration type*) had a significant correlation with *Level of Innovation*. This is an interesting outcome of the regression when contrasted to the outcomes of the crosstabulations and Chi-square tests. No significant level of association was found between any of the variables describing *Collaboration type* (x2a-b, x3a-b) and *Level of innovation*.

In contrast, these tests did indicate significant associations between *Source of technology* (x1) and *Level of innovation*, formal linkages with both firm and non-firm actors (x4a and x4b) and *Level of innovation*, as well as a significant association between the Level of innovation of firms that did not form any linkages with either firm or non-firm actors (x6a and x6b). However, the variable for Firm actors: No linkages (x6a) had to be removed due to high VIF.

TABLE 5.3.2.4

TABLE OF COEFFICIENTS

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	0.225	0.032		6.971	0					
	India	-0.044	0.021	-0.104	-2.083	0.038	-0.197	-0.082	-0.077	0.551	1.813
	South Africa	0.13	0.059	0.204	2.219	0.027	0.322	0.087	0.082	0.162	6.179
	Agro-processing	0.052	0.061	0.076	0.855	0.393	0.306	0.034	0.032	0.172	5.804
	Standalone	-0.003	0.018	-0.008	-0.179	0.858	0.049	-0.007	-0.007	0.75	1.333
	HQ of MNC	-0.042	0.024	-0.075	-1.752	0.08	-0.122	-0.069	-0.065	0.75	1.333
	Firm size (median)	-3.44E-05	0	-0.045	-1.034	0.301	0.044	-0.041	-0.038	0.725	1.379
	International sales	-0.015	0.024	-0.039	-0.593	0.553	-0.166	-0.023	-0.022	0.32	3.128
	% sales from exports	-5.91E-05	0	-0.01	-0.167	0.868	-0.097	-0.007	-0.006	0.416	2.406
	Internal market	0.041	0.059	0.028	0.696	0.487	-0.002	0.028	0.026	0.857	1.167
	Domestic market	0.026	0.025	0.061	1.064	0.288	0.055	0.042	0.039	0.419	2.385
	Export market	0.022	0.034	0.05	0.648	0.517	-0.111	0.026	0.024	0.227	4.403
2	(Constant)	0.234	0.038		6.23	0					
	India	**-0.06	0.023	-0.14	-2.597	**0.01**	-0.197	-0.103	-0.096	0.475	2.107
	South Africa	*0.114	0.06	0.179	1.888	**0.059**	0.322	0.075	0.07	0.152	6.568
	Agro-processing	0.051	0.061	0.075	0.837	0.403	0.306	0.033	0.031	0.171	5.847
	Standalone	0.006	0.019	0.013	0.289	0.773	0.049	0.012	0.011	0.674	1.484
	HQ of MNC	*-0.045	0.024	-0.08	-1.839	**0.066**	-0.122	-0.073	-0.068	0.719	1.391
	Firm size (median)	-3.65E-05	0	-0.048	-1.078	0.281	0.044	-0.043	-0.04	0.699	1.43
	International sales	-0.019	0.026	-0.051	-0.735	0.463	-0.166	-0.029	-0.027	0.279	3.583
	% sales from exports	0	0	-0.021	-0.349	0.727	-0.097	-0.014	-0.013	0.383	2.614
	Internal market	0.046	0.059	0.031	0.774	0.439	-0.002	0.031	0.029	0.845	1.184
	Domestic market	0.026	0.025	0.061	1.033	0.302	0.055	0.041	0.038	0.399	2.509
	Export market	0.008	0.035	0.018	0.221	0.825	-0.111	0.009	0.008	0.213	4.703
	Source of technology (x1)	-0.003	0.007	-0.017	-0.398	0.69	-0.021	-0.016	-0.015	0.773	1.294
	Firm actors: Local collaboration (x2a)	0.005	0.008	0.037	0.682	0.495	0.01	0.027	0.025	0.472	2.12
	Non-firm actors: Local collaboration (x2b)	0.002	0.008	0.016	0.272	0.786	0.005	0.011	0.01	0.414	2.416
	Firm actors: Global collaboration (x2c)	*0.008	0.004	0.112	1.818	**0.07**	0.012	0.072	0.067	0.364	2.748
	Non-firm: Global collaboration (x2d)	0.003	0.007	0.022	0.388	0.698	0.015	0.015	0.014	0.432	2.315
	Firm actors: Formal	-0.009	0.01	-0.047	-0.841	0.4	-0.141	-0.034	-0.031	0.446	2.24
	Firm actors: Informal	0.009	0.016	0.027	0.594	0.552	0.084	0.024	0.022	0.678	1.474
	Non-firm actors: Formal	0.003	0.014	0.016	0.22	0.826	-0.074	0.009	0.008	0.252	3.961
	Non-firm actors: Informal	-0.017	0.019	-0.044	-0.892	0.373	0.023	-0.036	-0.033	0.576	1.737
	Non-firm actors: None	-0.001	0.01	-0.008	-0.127	0.899	-0.024	-0.005	-0.005	0.359	2.784

a. Dependent Variable: Innovation Score

b. The baseline for *Country* is China, the baseline for *Industry* is ICT, the baseline *Company type* is Subsidiary of an MNC, the baseline for *Market type* is Regional market

c. *p <0.10; **p <0.05

The following salient features of the model bear mention:

- The intercept (0.234) was the predicted *Level of Innovation* for a firm that has no business networks. However, no firm in the sample had zero business networks. In this case, the intercept served as an anchor for the regression line that allows for Y values to be predicted over the range of observed X values (Albright, Winston & Zappe, 2009).
- The slope for the variable India (*Country*) (X_1) indicated that the *Level of Innovation* index tended to ***decrease*** by about -0.06 for each 1-unit ***increase*** in X_1, while all other variables in the equation remained constant. Therefore, if we compared two firms, where Firm 1 was in India and Firm 2 was not, it can be predicted that the measured *Level of Innovation* for Firm 1 would be -0.06 lower than the projected *Level of Innovation* for Firm 2. India (*Country*) therefore served as a suppressor variable.
- The slope for the variable South Africa (*Country*) (X_2) indicated that the *Level of Innovation* index tended to ***increase*** by about 0.114 for each 1-unit ***increase*** in X_2. Therefore, if Firm 1 was in South Africa and Firm 2 was not, it can be predicted that the measured *Level of Innovation* for Firm 1 would be 0.114 higher than the projected *Level of Innovation* for Firm 2.
- The slope for the variable Headquarters of an MNC (*Company structure*) (X_3) indicated that the *Level of Innovation* index tended to ***decrease*** by about -0.045 for each 1-unit ***increase*** in X_3. Therefore, if Firm 1 was the headquarters of an MNC and Firm 2 is not, it can be predicted that the measured *Level of Innovation* for Firm 1 would be -0.045 lower than the projected *Level of Innovation* for Firm 2. Headquarters of an MNC also served as a suppressor variable.

- The slope for the variable Firm actors: Global collaboration (*Collaboration type*) (X_4) indicated that the *Level of Innovation* index tended to ***increase*** by about 0.008 for each 1-unit ***increase*** in X_4. Therefore, if Firm 1 actively collaborated with other firm actors on a global level and Firm 2 does not, it can be predicted that the measured *Level of Innovation* for Firm 1 would be 0.008 higher than the projected *Level of Innovation* for Firm 2. Taking the standard error into consideration, X_4 (s.e. = 0.004) was the best predictor of innovation.

In summary, the results of the analysis presented allowed the researcher to answer the question posed. The model, which included control for external demographic variables, allowed the researcher to explain 10.9% of the variance in level of innovation. Of the variables tested, the control variables of India (*Country*), South Africa (*Country*) and Headquarters of an MNC (*Company structure*) had statistically significant correlation coefficients, as did the predictor variable Firm actors: Global collaboration (*Collaboration type*). These variables were therefore included in the model.

5.3.2.5. Tests for robustness

To consider the possibility that firms are simply not collaborative in their orientation, whether through formal or informal linkages, the values for x3a – f were collapsed as follows:

- If any collaboration was indicated across variables x3a – d, the instance was indicated as a *collaborator*;
- If no collaboration was indicated across variables x3a – f, the instance was indicated as a *non-collaborator*.

Likewise, this further assisted in controlling for any potential confusion on the side of respondents when confronted with a possible double negative in answering this question, essentially recoding the data set to invert negative values (Pallant, 2010, p. XXX). To ensure that the granularity of interpretation was not lost, the new variable Collaborator was singularly included in the model, as well as in conjunction with the original variables related to Formal linkages (x3a – b) and Informal linkages (x3c – d).

TABLE 5.3.2.5

TESTS FOR ROBUSTNESS

Model	R2 value	Adj R2 value	F	Sig
Model 4 (as presented in Table 5.3.1)	0.138	0.109	4.783	0.000
With Collaborator (EXCL formal/ informal)	0.135	0.112	5.809	0.000
With Collaborator (INCL formal/ informal)	0.138	0.109	4.786	0.000

As presented in **Table 5.3.2.5**, the results were substantively the same. While marginal improvements in the adjusted R^2- and F-values were recorded when the original variables (x3a – d) were excluded, these improvements were lost when they were added to the model. The significance of individual predictor variables were however lost with these versions of the model, with only India (Country) (negative association) and South Africa (Country) remaining. In the interest of granularity, it was therefore decided to retain Model 4, as presented and discussed in the sections above.

5.4. Conclusions of the hypothesis testing

Table 5.4 summarises the conclusion of the proposed hypotheses testing of this study.

TABLE 5.4

SUMMARY OF THE HYPOTHESIS TESTING

	Main hypothesis	Null hypothesis	Test variable	Reject Ho at .05 significance level?	Probability
1	The innovation level of firms in emerging economies that buy external sources of technology (from other firms or public sector organisations) is higher than those that produce technological inputs internally.	The level of innovation of firms that buy external sources of technology is higher than or equal to those that produce technological inputs internally.	x1	Reject	0.008
2	The innovation level of firms in emerging economies that actively collaborate with non-firm actors (consulting companies, government and research institutions) is higher than those that collaborate with firm actors (clients, suppliers, competitors).	The level of innovation of firms that collaborate with non-firm actors is higher than or equal to those collaborate with firm actors.			
a	The innovation level of firms in emerging economies that actively collaborate with local non-firm actors (consulting companies, government and research institutions) is higher than those that collaborate with local or global firm actors (clients, suppliers, competitors).	The level of innovation of firms the collaborate with local non-firm actors is higher than those that collaborate with local or global firm actors.	x2a, x2b, x3a	Reject	0.206
b	The innovation level of firms in emerging economies that actively collaborate with global non-firm actors (consulting companies, government and research institutions) is higher than those that collaborate with local or global firm actors (clients, suppliers, competitors).	The level of innovation of firms that collaborate with global non-firm actors is higher than those that collaborate with local or global firm actors.	x2a, x3a, x3b	Reject	0.81
3	The innovation level of firms in emerging economies that develop formal links with other firm and non-firm actors is higher than those that develop informal links, or have no linkages at all.	The level of innovation of firms that develop formal links with firm and non-firm actors is higher than those that develop informal links, or have no linkages at all.			
a	The innovation level of firms in emerging economies that develop formal links with firm actors is higher than those that develop informal links, or develop no linkages at all.	The level of innovation of firms that develop formal links with firm and non-firm actors is higher than those that develop informal links, or have no linkages at all.	x4a, x4b, x5a, x5b, x6a, x6b	Accept	0.016 0.049
b	The innovation level of firms in emerging economies that develop formal links with non-firm actors is higher than those that develop informal links, or develop no linkages at all.	The level of innovation of firms that develop informal links with firm and non-firm actors is higher than those that develop formal links, or have no linkages at all.	x4a, x4b, x5a, x5b, x6a, x6b	Reject	0.056 0.74

CHAPTER 6: FINDINGS AND INTERPRETATIONS

6.1. General characteristics

Current literature on the characteristics and patterns of business networks and its influence on innovation is mainly based on theoretical models or studies conducted in developed countries. The central argument of this study is that the nature of these characteristics as well as its use to foster innovation are expected to be different in emerging market countries like Brazil, China, India and South Africa. This expectation is based on evidence from the literature that institutional frameworks impact the nature and type of innovation required, and that these frameworks, along with the business networks that exist alongside them, differ between emerging markets and developing countries (like Brazil, China, India and South Africa) and developed markets.

The findings of this research presented some evidence regarding the patterns of innovation levels present among firms that utilised different sources of new technology, various collaboration types across different geographies as well as formal and informal linkages. It also highlighted the underlying complexity of trying to assess this relationship, with numerous factors that could have an impact on, or be impacted by, each other. This complexity is to be expected and supports the potential contribution this research can make to the body of knowledge. So far as the relationship between innovation and business networks is concerned; the findings of this research agree with some of the claims made by in the literature and finds some interesting new evidence.

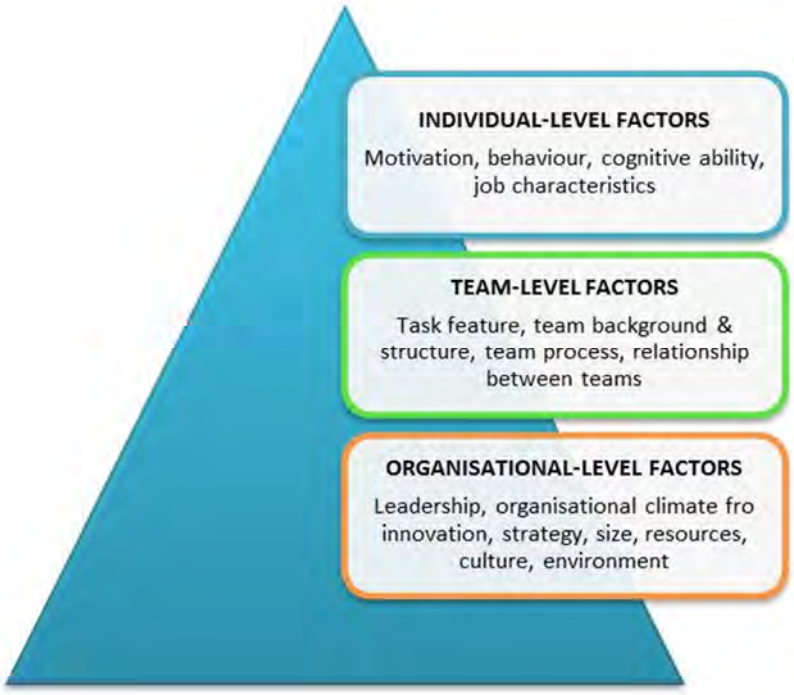
6.1.1. The predictive validity of the model

The low percentage (10.9%) of variance explained by the model in the prediction of level of innovation of a firm based on its business networks points to the probability that business networks explained only a part of what makes one firm more innovative than another.

In a paper summarising a meta-study on the key factors that affect organisational creativity and innovation, Rui (2006) found 29 key factors at individual level, 28 key factors on team level and 27 key factors at organisational level.

FIGURE 6.1.1

SUMMARY OF KEY FACTORS AFFECTING ORGANISATIONAL CREATIVITY AND INNOVATION



(Source: Adapted from Rui, 2006)

Rui (2006) further purported that the key determinant for innovation at an organisational level was a match between individual/ team level behavior, market demand and the organisational target. The low predictive ability of the model would therefore make sense when considering the multitude of different factors that influence the level of innovation of a firm.

However, it remains important for researchers to try and understand these relationships, as a meta-analytical study by Vincent et al. (2004) found that innovation is significantly and positively related to superior performance. They also found that organisational capabilities and structure account for the majority of unique variance explained in predicting innovation. Furthermore, innovation levels are also impacted by industry (Pavitt, 1984) and stage of development (Poulymenakou & Prasopoulou, 2004).

6.1.2. The overall level of innovation

The overall level of innovation measured across all firms was low, with about a quarter reporting no innovation (***** = 23.3%), the majority a low level of innovation (**i** = 70%) and only a small percentage reporting high levels of innovation (**I** = 6.7%). This finding supports Chaminade and Plechero's (2010) contention that this pattern of innovation is typical in developing economies where economic institutions are less expansive. Regardless of support from the literature, this finding raises a number of questions on why most organisations seem to achieve only incremental innovation, as well as inferences that can be drawn from the behaviour of organisations and their subsequent levels of innovation.

The innovation level index that was developed in operationalising the dependent variable used weighted measures. Therefore, a firm that experienced innovation that was *New to*

the world or *New to the industry*, would have a higher innovation level score than a firm that experienced innovation that was *New to the firm*. Therefore, a low score on the innovation level could indicate more localised innovation, as opposed to no innovation. This contention is supported by work done by Barnard and Chaminade (2011), which found that most of the *New to the world* innovations are being implemented by firms with headquarters in developed economies, while emerging market firms display mainly so-called "imitative innovation". According to their findings, this would indicate that these emerging market firms acquire technology in developed markets and then adapt it to local needs to design new products.

This raises the question of whether it is only the "big innovations" that count, or whether firms that make small incremental changes on a continuous basis actually present a more sustainable model of innovation. It also questions how firms measure innovation – what may be low-level innovation to some, may be mere small incremental changes for others.

Consistent with the findings in this study, Day (2007) found that the largest part of firms' development portfolios consistent of minor innovations. However, innovation that is new to the company or new to the world is more likely to push the firm into new markets or technologies, inadvertently to improve the bottom line. Multinationals from emerging markets are increasingly choosing horizontal investments over the more traditional vertical investments, a choice that is driven by the possession of intangible assets (Guillén & Garcia-Canal, 2009). Of course, innovation cannot be the only driver for international expansion and the underlying strategic subtleties of competitive advantages stable currencies, industry concentrations of foreign direct investment (Klein & Wöcke, 2009) should not be overlooked.

In contrast, this study showed that most firms with high levels of innovation (**I** = 47.9%) indicated the domestic market as their enterprise's largest market, with a significant number of firms with no innovation (***** = 37.5%) operated in the export market. This may indicate that firms without exposure to the international marketplace tend to overvalue their own innovativeness, whereas firms with closer experience of other firms and more exposure to their innovation will assess themselves more cautiously.

However, it can also be postulated that this may be one of the multiplier effects of globalisation – that even firms with so-called "little i-innovation" (Day, 2007) can have global reach. The existence of viral products and servicing of niche markets based on long-tail theory (Brynjolfsson, Hu& Smith, 2006) may explain the observed multiplier effect.

The following sections describe the findings and interpretation of the major results.

6.2. Hypothesis 1: Are firms that use external sources of technology more innovative than those that do not?

In reviewing the literature related to this question, opposing views were identified. While some authors maintained that the firm's own innovative capabilities were an important indicator of a firm's performance (Zaheer & Bell, 2005), earlier work indicated that strategic business collaborations was an important resource to overcome barriers to innovation (Dickson & Hadjimanolis, 1998), especially in the context of SMME's and emerging markets (Van Laere & Heene, 2003).

The cross-tabulations performed in this study between *Source of technology* (x1) and *Level of innovation* supported the first claim, with firms who produced the majority of their

technological inputs in-house accounting for 52.1% of overall innovation. However, although these firms did innovate, their level of innovation was low.

This links to the pertinence of industry when trying to determine influence on level of innovation. Pavitt (1984) developed a typology to describe and analyse sectoral patterns of technical change, finding that the source of innovation can often be linked to the sector in which a firm operates. For example:

- Innovating firms in electronics and chemicals sectors develop innovations over a wide range of specific product groups within their principal sector, with relatively little input from outside;
- Firms principally in mechanical and instrument engineering and vehicle manufacturing exist in symbiosis with larger firms, who made significant contributions to their process technology; and
- Textile firms generally rely on suppliers for most of their process innovations.

It therefore made sense to have the automotive industry removed from the regression analysis. The hierarchical structure of the industry, supported by heavy subsidisation in emerging market countries like Brazil, would have skewed the observation on *Source of technology*.

The supposition that firms in emerging markets found access to innovation through collaboration with non-firm actors like public-sector organisations (McDermott & Corredoira, 2010; Gulati, 1999) was refuted, with the lowest levels of innovation (2.8% of total *Level of innovation*) observed in firms falling in this category. This contrasts with findings in developed economies, yielding factor coefficients of 0.66 – 0.80 for

contributions towards innovation from the public knowledge infrastructure (Oerlemans, Meeus, & Boekema, 1998).

This begs the question of whether these types of non-firm actors do not provide sufficient support to firms in the development of innovation and technology, or whether they are simply not front-of-mind for firms looking for potential partners to bolster their innovation efforts. It could also indicate that these non-firm actors differ substantially in nature and function between developed and developing economies.

The low level of innovation observed when firms produce most of their technological inputs in-house became pertinent when considering the earlier work of Van Laere and Heene (2003) and Dickson and Hadjimanolis (1998). Research has shown that while technology is an important source of innovation, disruptive business models are more likely to arise when technology combines with extreme market conditions (Bughin et al., 2010). Therefore, while incremental innovation does yield results, radical innovation is more likely to be developed through collaboration on a global scale.

This prompts the question; if the business models developed in emerging markets are disruptive enough to really position these markets as technology-enabled innovators as opposed to traditional manufacturing hubs. Due to the nature of the market infrastructure in which they operate, firms may have been able to survive with low levels of innovation, if developed on a continuous basis.

However, as competition increases and markets become further fragmented, it may be proposed that firms will increasingly need to collaborate with external firm and non-firm actors to obtain access to the kind of technology that will allow them to develop disruptive

business models. This contention contrasts with the observation of some conglomerates with national interests increasingly dominating whole areas of international business, stifling competition through the use of non-firm actors, for example Brazilian and Chinese mining and industrial development conglomerates working closely with and being funded by government and parastatals. The subtlety of this finding may require further analysis of the interaction between firm- and non-firm actors, industry type and innovation.

Based on the overall analysis it would therefore appear that firms who used external sources of technology were not necessarily more innovative than those who did not, and consequently this hypothesis was rejected. However, this study also indicated a significant positive association between *Source of technology* and *Level of innovation*. It would therefore follow that stimulating and enabling more optimal usage of and access to appropriate technology sources has a positive impact on the level of innovation.

6.3. Hypothesis 2: Do firms benefit more from certain collaboration types than others?

Previous research in advanced and emerging economies pointed to firms often being dependent on non-firm actors, such as consultants, banks, associations, universities and public agencies to acquire new skills and practices (McDermott & Corredoira, 2010; Gulati, 1999). Small firms were found to particularly benefit from alliances with large and innovative strategic partners (Stuart, 2000). The concept of *systems of innovation* reinforced this idea of systemic interaction between firms and a large number of institutions (Geels, 2004). This highlights the necessity of incorporating internal and external sources of knowledge to the firm, either through collaboration or through market mechanisms (Garcia & Molero, 2005).

With emerging markets being home to a large number of start-ups and SMME's, the assumption may be that these alliances are formed with larger, more established partners on a global level. However, the literature pointed to the most benefit derived from partnerships with local non-firm actors that can provide access to training and research-and-development facilities (McDermott & Corredoira, 2005; Zhao et al., 2005). This is pertinent, particularly if one is looking at the structure and participants of innovation hubs in emerging markets.

While the largest percentage of collaboration was observed with local firm actors (62.8%), a number of firms also indicated collaboration with non-firm actors in order to develop innovation (44.4%). Although some innovation benefit was derived from these partnerships, it did not lead to high levels of innovation, with 94.7% of these firms indicating a low level of innovation (73.1%) or no innovation at all (21.6%).

An interesting finding was that 40.6% of firms indicated collaboration with global firm actors to develop innovation and 24% indicated collaboration with global non-firm actors. Again, this yielded average innovation levels, with the number of firms indicating high levels of innovation through collaboration with global firm actors (2.4%) only slightly higher than those that collaborated with global non-firm actors (1.4%). Despite the fact that only marginally significant associations were indicated between any of the sub-variables related to *Collaboration type* and *Level of innovation*, the regression analysis pointed out that collaboration with global firm actors was the strongest predictor of innovation level in the model (s.e. = 0.004).

This finding seems to indicate that firms in emerging economies are missing a significant innovation development opportunity if they do not collaborate with other global enterprises,

specifically global firm actors. It refutes the contention that firms in emerging markets derive most benefit from collaboration with non-firm actors in order to access their research and training facilities to drive innovation practices and acquire new skills and capabilities (McDermott & Corredoira, 2010; Zhao et al., 2005; Gulati, 1999). On a broader level, it supported the underlying concept of systems of innovation (Geels, 2004), specifically the contention that firms cannot dismiss the opportunities that collaboration with a broad range of actors, specifically on the global stage, provides. Multinational theory supports this by contending that global alliances and acquisitions are used by MNC's *from* emerging markets and *in* emerging markets to "…simultaneously overcome the liability of foreignness and to gain access to their competitive advantages with the aim of upgrading their own resources and capabilities" (Guillén & García-Canal, 2009, p.28).

Linked to this is the question of where in the firm structure collaboration and networking should be seated in order to have the biggest impact on innovation. The regression analysis indicated that Headquarters of an MNC (*Company structure*) served as a suppressor variable, indicating that this type of company structure is likely to have lower levels of innovation than a standalone company or a subsidiary of an MNC (the other two sub-categories measured in the variable).

One possible reason for this observation may be that small firm advantages are mainly behavioural, while those of large firms are mainly material (Garcia & Molero, 2008). This would mean that the behaviour of small firms – their agility, their openness to market influence and information absorption – provides them with certain advantages over large firms. It could be argued that large firms often forfeit these kinds of interactions because their size makes them unwieldy. Furthermore, their material advantage allows them to buy

a lot of the technology they require, whether in the form of human resources skills and capabilities or the technological outputs of other firms.

Similarly, subsidiaries of MNC's may behave more like small firms while the centralised headquarters of an MNC is likely to mimic the behaviour of large firms. This is of interest as general management and organisational design theory would hold that innovation ability in MNC's is driven by headquarters, as this is where the centralised function of and the budget for research and development resides.

Furthermore, innovation is generally enabled and encouraged by the kind of support functions available at the centre, or innovation is outsourced completely. Like small and large firms, MNC's and their subsidiaries do not operate in isolation, leading to a variety of complementary relationships and spill over effects related to technology and innovation. For example, the success or failure of these structures will include the influence of industry-specific characteristics and the importance of "soft issues" like branding, leadership styles and training approaches. The headquarters of immature MNC's may struggle to coordinate and innovate consistently across their subsidiaries and business units.

This contention is supported by research on the "liability of foreigness" (Hymer, 1976; Zaheer and Mosakowski, 1997), investigating how emerging multinational firms manage the demands of a technologically and economically highly developed host country. Evidence exists that purchasing knowledge provides an accessible strategy for overcoming some liabilities of foreignness (Barnard, 2010). Collaborative relationships with global actors, particularly other firms, therefore seem to be a valuable resource for firms in emerging markets.

6.4. Hypothesis 3: Do firms need formal linkages to reap the benefits of innovation?

The literature reviewed pointed to firms often participating in informal networks for the purposes of development, exchange and dissemination of knowledge (Allen et al., 2007), while formal networks denote more permanent, contracted alliances (Stuart, 2000).

Conflicting views exist on the use of formal and informal linkages in emerging market countries. While many foreign investors prefer formal linkages and institutionalisation of relationships due to the weak institutions and public resources (Li, Poppo & Zhou, 2010; McDermott & Corredoira, 2010), firms operating in these countries themselves prefer more robust informal linkages and contractual arrangements (Khwaja et al., 2007).

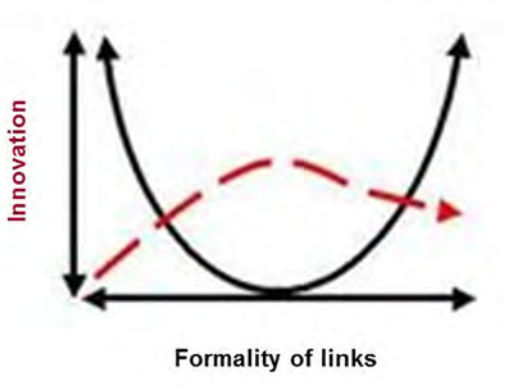
Further contrasts exist in how formal and informal networks are used. Weak ties help firms to build initial relationships and strong ties help firms to acquire higher-quality and fine-grained knowledge (Mu et al., 2008). However, informal linkages may be based on a higher level of trust, making it more likely that covert knowledge and trade secrets will be imparted (Malhotra & Murnighan, 2002).

The firms observed in this study operated at the opposite extremes of this continuum, with significant associations between formal linkages with firm and non-firm actors and innovation, as well as a significant association between the level of innovation of firms that did not form any linkages with either firm or non-firm actors. Formal linkages with firm actors accounted for 64.2% of overall innovation in that category; supporting the findings of Mu et al. (2008).

The observation that firm innovation exists at opposite ends of a continuum correlates with related research on innovation. In investigating the association of firm size with research and development (R&D) expenditure (Garcia & Molero, 2005), a similar dichotomous observation was noted. While the majority of innovative small firms did not have any specialised R&D programmes, several small firms that performed R&D had above average innovation intensities. The association between firm size and R&D effort is positive up to a point, after which the dominant relation is a proportional one (Cohen, 1995 in Feldman, 1999).

Of the firms with no linkages, 56.1% of firms reported no linkages with firm actors and 66.1% reported no linkages with non-firm actors; an average of 61.1% of respondents indicated no linkages. Interestingly enough, these firms did still manage to collect significant innovation scores. This seems to support the logic of the argument proposed in Section 6.1.1 that business networks are only one of a multitude of factors that impact innovation output.

FIGURE 6.4



It is difficult to make a conclusive judgement on the question of whether firms need formal linkages to truly reap the benefits of information and knowledge sharing in order to access innovation. A significant positive association exists between the existence of formal linkages and innovation, but also between the absence of linkages and innovation. This can probably best be described using U-shaped logic, with *innovation* presented as a normal bell curve and *formality of links* as an inverted bell curve (see **Figure 6.4**). In trying to draw a conclusion in order to make a recommendation, one

might consider that the global recession underscored the value of porous, networked organisations (Bughin et al., 2010) and flexible access to innovation (Rigby et al., 2009) in managing volatility.

While *No linkages* do seem to be associated with innovation, organisations in emerging markets may be more prudent to cast their die on the opposite extreme of the continuum, and focus on formal linkages, both with firm and non-firm actors. This may unlock ultimate conditions for innovation through a strategic mix of formal and informal linkages given a particular set of circumstances, taking into account industry, region and political economic factors.

6.5. Interpreting the findings within the South African context

At this point, wrapping up the discussion on key findings before considering concluding remarks and recommendations, it may be appropriate to make some comments on strategic performance in terms of innovation specific to the South African context. The South African Innovation Survey 2005 (SAIS2005) found that around 52% of South African firms had technological innovations in the period 2002-2005, an increase of 8 percentage points from the previous survey published in 2001. This figure is surprisingly high when compared to that of many developed countries in Europe, and supports the finding that operating in South Africa was found to be a supporting variable for innovation in firms.

The majority of innovations of South African firms were incremental (supporting the distribution of overall innovation found in this study) and larger firms had higher innovation rates than smaller firms. The SAIS2001 further found that a third of the development of new or improved products and/or services was done by or together with a third party

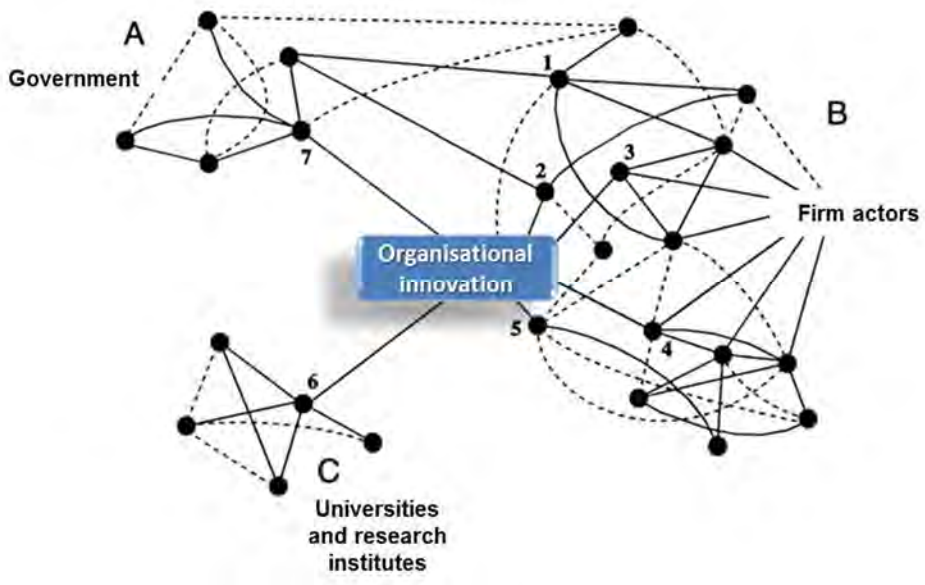
(32%). About one in every four innovating firms (26%) participated in innovative partnerships with organisations outside South Africa. Supporting the importance of business networks - especially on the global stage - as an enabling factor for innovation, this indicated a dependency on external knowledge and contributions.

6.6. What do these patterns of linkages mean for the various stakeholders of an organisation?

The various stakeholders of an organisation considered to benefit from the findings of this research include policy-makers at government-level, shareholders, managers, universities and research institutes as well as firms wanting to know how they can use business networks to enhance their innovation levels.

FIGURE 6.6

PATTERNS OF LINKAGES BETWEEN ORGANISATIONAL STAKEHOLDERS



(Source: Adapted from Burt, 2000)

It is pertinent for stakeholders to understand the value that business networks may add to the innovation ability of firms in emerging markets. This will not only assist the firms themselves, but also policy makers. Innovation is the engine that drives economic growth and industry change. This is increasingly important in times of disruptive economic conditions (Rigby et al., 2009) and therefore important as an element of organisational strategy. Time and energy are scarce resources and firms need to know where and how to expend these to reap maximum returns. Policy makers need to know which kind of environment will enhance the firm's ability to innovate, grow and prosper, thereby contributing to national economic growth and industry competitiveness.

The interaction between business networks and the firm's level of innovation as discussed in this study will hopefully assist the various stakeholders to understand the value of these connections. This will assist them in developing policies, business strategies and networking opportunities to encourage information flow and mutually advantageous cooperation between firms and markets. Besides technological innovations, firms can be innovative by changing for example their business strategies or by changing their organisation. The focus in emerging markets should increasingly move to true innovation, rather than clever imitation.

The next chapter discusses the specific recommendations in this regard along with the discussion of the main findings of the study and future research.

CHAPTER 7: CONCLUSION AND RECOMMENDATIONS

7.1. Recommendations to stakeholders

Networking, particularly innovative networks, is a critical vehicle for industrial and economic development in developing countries. Emerging economies are increasingly operating at the so-called “technological frontier” for the development of knowledge. However, business owners in emerging economies like South Africa continue to indicate a need for assistance in growing and sustaining their businesses. This need for assistance often take on the form of assistance with marketing, better access to raw supplies and forming contacts with others in similar businesses to form cooperatives (Statistics South Africa, 2009), but also increasingly access to funding and skills are cited as challenges (South African Innovation Survey, 2005) It is easy to see how these needs could be mitigated by the increased utilisation of business networks.

In view of the literature review and the findings of this research project, a number of recommendations can be made to stakeholders. Three key stakeholder groupings have been identified: policymakers and parastatals (representing government as a whole); corporate business and managers; and entrepreneurs.

An overview of some of the key recommendations is presented in **Figure 7.1**, after which the details of recommendations to each of the stakeholder groupings are presented.

FIGURE 7.1

SUMMARY OF RECOMMENDATIONS TO KEY STAKEHOLDER GROUPINGS

7.1.1. Recommendations to policymakers and parastatals

The following recommendations can be made to policymakers and parastatals:

- The growth of innovation in a market economy is supported by the growth and flourishing of the small business sector. Government plays a key role in the incubation and support of small business through transparent and efficient regulations, and government-supported linkages between universities, research institutions and business.
- Government further plays a role in providing the supporting structures, databases and forums of engagement to link potential innovators and business owners with each other, as well as with institutions that can support them in this regard.

- Encouraging competitive and transparent practices stimulate entrepreneurial activity. Developing economies need to structure their economies to encourage competition in particular areas of focus and excellence to harness the country's natural comparative advantage. This should be supported by a willingness to engage with innovators, small business owners and social entrepreneurs.
- Encouraging internal competition should go hand-in-hand with incentives for international partners to introduce new technologies and innovative practices to the local economy, with the caveat that it must also include knowledge and skills transfer and comprehensive training and development opportunities. The flipside of this coin is supporting innovative local industries and businesses to expand on a global scale.
- In support of entrepreneurial activity, supporting business mechanisms is key. The close link between country competitiveness and innovation highlights the importance of the ease of business indicators in enabling innovation to grow. This includes the identification and removal of unnecessary bureaucracy and red tape, especially for small business owners, the hallmark of emerging market economies.
- A key consideration for emerging markets is that innovation thrives where a nation has cheap and abundant internet connectivity. Emerging markets often lag in development due to the inability to adopt and access key technology trends.
- All these recommendations will ring hollow if there are no people to support it. Education is the key to develop young inquisitive minds and turn them into successful innovators and business owners of the future. With the increased globalization of innovation networks, countries, their businesses and their citizens face international competition. Furthermore, emerging market economies increasingly face the challenge of limited resources to address social development issues. These issues can only be solved through the development of innovative

new products, services and processes. Solid education practices from the earliest age will ensure that emerging markets too are able to take up the challenge and participate in their portion of the opportunity.

- This study has specific implications for the South African market. Supporting and further developing a proven innovative and globally competitive sector like agro-processing creates numerous opportunities for entrepreneurial activity, job creation and eradication of poverty among rural communities.

7.1.2. Recommendations to corporate business and managers

The following recommendations can be made to corporate business and managers:

- Regulation often suppresses innovation. For example, while South Africa has arguably one of the best banking and financial services sectors in the world, the tight regulation of this sector inhibits innovative thinking. The question can be asked if these industries will remain globally competitive without some form of innovation. Many opportunities exist *within* these regulatory frameworks and business should be encouraged to explore and exploit these – regulation should not be seen as a prescriptive barrier to all types of innovation.
- One way of doing this is through collaborative business networks, exploring perpendicular innovation. Managers should be encouraged to foster relationships not only within their own industry, but also to look at new developments in other industries and sectors to consider their novel application within the current business framework.
- Internally, organisations should foster a culture of “try and learn”. Managers and their project teams should not only be rewarded for building the best solution

according to conventional wisdom, but be encouraged to design novel approaches with a systemic impact and future sustainability.

- Emerging markets are rife with innovative ideas and entrepreneurs looking for opportunities to implement them. One of the major obstacles remains linking funders with inventors. Private sector funding for the developmental space is key. Corporate innovation development programmes and funds, linked through government partnerships to ensure access to citizens from all levels of society, will not only encourage innovation but also support the early identification of talent and the creation of a more sustainable society.
- Increasingly, innovation is developed though collaborative approaches like crowd-sourcing. One way of staying ahead of the competition is exploiting all the resources at the business's disposal, including sources at the periphery. An effective way to gain access to these sources is through networks, especially those that span conventional organisational boundaries and units.
- Reward collaboration behavior in your organisation and use this learning to assimilate novel project teams. Many businesses are doing innovative things, but are using mechanisms and vehicles that are already in place and therefore easy to access. Counter-intuitive connections are often the source of disruptive ideas, yielding the highest levels of innovation.

7.1.3. Recommendations to entrepreneurs

The following recommendations can be made to entrepreneurs:

- Many entrepreneurs in emerging markets cite lack of funding and skills as key inhibitors to innovation. This research study has shown that fostering effective business networks, not only locally but on a global level, is an important way of getting around these constraints.

- Flying in the face of conventional wisdom, collaboration with competitors can not only improve innovation, but also ultimately contribute to improved access to market and higher profit-taking.
- While incremental innovation is sustainable, only disruptive change can change the face of an industry or market and lead to the highest levels of profit taking and ultimately sustainability. Entrepreneurs should weigh up the advantages of being a "slow innovator" as opposed to a "quick follower".

7.2. Recommendations for future research

The recommendations for future research are as follows:

i. This study was constrained in terms of sample size, with only four countries and three industries, which had to be more even more controlled in the final regression model. It is recommended that the inclusion of firms from other industries and sectors, as well as other emerging markets, will improve the ability to generalize and infer;

ii. It is also recommended that this study be duplicated or expanded to include countries and industries from developed markets in order to determine if the impact of business networks differ between emerging and developed institutional environments;

iii. Based on the interesting outcome of the regression model, indicating South Africa as a supporting variable, while indicating India as a suppressor variable, it might be worthwhile to further investigate the impact that country-specific culture has on the use of business networks to foster innovation;

iv. There are a number of research recommendations focusing on improving understanding of the functioning and value of business networks. These include:

a. This research did not provide insight into the value of more ties to unconnected network nodes. While the data indicated relationships between firms and organisations, it did not shed light on whether firms gain more innovation traction from connecting with already well-connected firms, or whether they should seek out the novel innovators at the periphery of their industries and markets. Access to less-connected ties means more access to ideas that have not been exposed elsewhere (Cross, 2011), which, in turn, is likely to lead to higher levels of innovation;

b. Further analysis of the type of inter-firm networks on the global stage that assists innovation development is required to support policy development and effective enabling support for enterprises in the emerging markets; and

c. The divisive nature of linkage types, indicating innovation at both the opposite ends of the continuum, bears further scrutiny. Based on the results of this research project, firms seem to be likely to have high levels of innovation if they exploit *all* networks, or if they participate in *no* networks. This dichotomous finding may be linked to the theories of incremental ("little i") innovation and disruptive ("big I") innovation.

7.3. Conclusion

Innovation is a critical element to organisations that want to achieve and maintain success over time (Rigby et al., 2009; Vincent et al., 2004). Business networks serve as a complementary framework to enable organisations to gain access to innovation development and knowledge creation.

The proportion of variance explained by the final regression model was relatively low. It was argued that this is can be explained in the light of the multitude of other factors that impact and enable – or prohibit – organizational innovation. Business networks can be seen as a very early step in fostering innovation. However, organisations require strong leadership to extract value from these linkages and gauge their strategic importance and usefulness. This research did not consider these intervening steps, rather moving the focus away from the individual and investigating the effect of other people, inter-firm relationships, infrastructure and the context of a developing economy on the level of innovation observed in a firm.

Today, more than ever before in history, the world has educated and connected citizens. The populations of emerging market countries are increasingly seen as key early adopters of new technologies. These individuals have high expectations of, and expect responsiveness from, their governments and the private sector. Innovation is how those expectations are met.

It can therefore be surmised that there is a growing awareness in emerging markets, among a range of stakeholders from the entrepreneurs at the coalface of economic value creation to policymakers as the enablers of this environment, that innovation is a key element of country competitiveness and therefore strategy formulation. In order to formulate appropriate strategies and policies, it is important that there is a clear picture of the economic and innovative performance of companies in emerging markets, and this research study aimed to present a contribution to further clarify this picture.

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Impact of Networks, Globalisation and their INteraction with EU Strategies

INGINEUS is an international research project funded by the European Union that studies global innovation networks. It involves 14 research institutes and universities in seven European countries plus Brazil, China, India and South Africa. For further information on the project INGINEUS please see www.ingineus.eu

In South Africa the Gordon Institute of Business Science is responsible for undertaking the survey on behalf of the research consortium INGINEUS.

The Gordon Institute of Business Science (see www.gibs.co.za) is fully responsible for the protection of your data. Your responses are treated with full confidentiality. Results are summarised in spreadsheets together with information collected from other enterprises in the sample. Data protection is fully guaranteed.

CONTACTS FOR SURVEY QUERIES:

If you have any questions to the survey, please contact the following persons:

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For more information on INGINEUS please visit our web site at www.inginues.eu .

- Answer by placing a cross in the relevant box, except where a written comment is needed.
- Answer for your specific enterprise e.g. stand-alone firm or specific subsidiary etc.
- Answer all questions as they relate to your enterprise in 2008.
- Where data for three previous years are requested, include 2006, 2007 and 2008.
- The abbreviation 'MNC' is used for 'multi-national corporation' throughout the survey.

1. Please briefly describe your enterprise's main product (goods or services)

1.1	Agro-processing	
1.2	ICT	
1.3	Automotive	

1.1.Main areas of focus (agro-processing)

101	Processing and preserving of meat and production of meat products	
102	Processing and preserving of fish, crustaceans and molluscs	
103	Processing and preserving of fruit and vegetables	
104	Manufacture of vegetable and animal oils and fats	
105	Manufacture of dairy products	
106	Manufacture of grain mill products, starches and starch products	
107	Manufacture of bakery and farinaceous products	
108	Manufacture of other food products	
109	Manufacture of prepared animal feeds	

1.2. Main areas of focus (ICT)

26:30:00	Manufacture of communication equipment	
62:01:00	Computer programming activities (This class includes the writing, modifying, testing and supporting of software)	
62:02:00	Computer consultancy activities	
62:03:00	Computer facilities management activities	
62:09:00	Other information technology and computer service activities	

1.3.Main areas of focus (automotive)

25241	Manufacture of technical parts and accessories of plastic	
28408	Pressing, stamping and roll forming	
2914	Manufacture of bearings, gears, gearing and driving elements	
3161	Manufacture of electrical equipment for engines and vehicles	
343	Manufacture of parts and accessories for motor vehicles and their engines	
74205	Engineering activities for projects in specific technical fields	
	Others	

Others (please indicate)

2. Are you:

2.1	A standalone company?	
2.2	A subsidiary of an MNC?	
2.3	The headquarters of an MNC?	

3.1. How many full-time equivalent (FTE) employees does your enterprise have?

3.1	Fewer than 10 FTE employees	
3.2	10 to 49 employees	
3.3	50 to 249 employees	
3.4	250 to 999 employees	
3.5	1000 or more employees	

3.2. Does your enterprise have a significant share of sales activity abroad?

YES		
NO		

3.2.1. If you answered 'Yes' to the question above then please provide the percentage (%) of total sales derived from export.

%	

3.3. Do you have significant R&D activity?

YES		
NO		

3.3.1. If you answered 'Yes' to the above then please estimate the number of full time equivalents employed in R&D.

4.1. In geographical terms, is your enterprise's largest market?

4.1.1	Internal to your enterprise	
4.1.2	A regional market (local region in your country)	
4.1.3	Domestic market (rest of the country)	
4.1.4	An export market	

4.2. If an export market (4.1.4) was selected then please indicate the 3 most important destinations in terms of sales.

4.2.1	North America	
4.2.2	South America	
4.2.3	Western Europe	
4.2.4	Central and Eastern Europe	
4.2.5	Africa	

4.2.6	Japan & Australasia	
4.2.7	Rest of Asia	
4.2.8	The rest of the world (developing)	

5. Which is the most important source of technology for your enterprise (including hardware, software and knowledge)?

5.1	We produce most technological inputs in-house	
5.2	We buy most of our inputs from other branches of our own MNC	
5.3	We buy most of our technological inputs from non-MNC firms	
5.4	We buy most of our inputs from MNCs with which we are not formally connected	
5.5	We buy most of our inputs from public-sector organisations, e.g. research institutes, universities etc	

6. Please indicate if your enterprise experienced innovation in the past 3 years (2006-2008) in any of the following. You may tick more than one option.

		New to the world	New to the industry	New to the firm	None
6.1	New products				
6.2	New services				
6.3	New or significantly improved methods of manufacturing or producing				
6.4	New or significantly improved logistics, distribution or delivery methods for your inputs, goods and services				
6.5	New or significantly improved supporting activities for your processes (e.g. purchasing, accounting, maintenance systems etc.)				

7. Regarding the development of the most important innovation of your firm in the last 3 years: who did you actively collaborate with and in which geographical location? Region refers to a sub national area, please select all that apply.

		Your Region	Your Country	North America	South America	Western Europe	Central & Eastern Europe	Africa	Japan & Australasia	Rest of Asia
7.1	Clients									
7.2	Suppliers									
7.3	Competitors									
7.4	Consultancy companies									
7.5	Government									
7.6	Local Universities/Research Institutions/Labs									
7.7	Foreign Universities/Research Institutions/Labs									
7.8	Other									

Other (please specify)

8. Has your enterprise developed formal/informal linkages (e.g. research relationships) with the following kinds of foreign organizations? (*Informal* implies no written contract or financial obligation exists)

Please tick all relevant boxes.

		Yes, formal	Yes, informal	No
8.1	Clients			
8.2	Suppliers			
8.3	Competitors			
8.4	Consultancy companies			
8.5	Government			
8.6	Foreign universities/research institutions/labs			
8.7	Other			

Other (please specify)

9.1. Regarding internationalisation, does your firm offshore (or has your firm offshored) production or any R&D activities? (*Offshoring* encompasses activities both internal and external to the firm for the purposes of serving home country or global markets in a location outside the enterprise's home country)

YES		
NO		

9.2. Complete only if 'Yes' selected in Question 9.1 above.
What were the important regional factors in the decision to offshore your enterprise's production and/or R&D innovation activities into a host region(s)?
Mark all important factors.

		Offshoring of production	Offshoring of innovation
9.2.1	Availability of specialised knowledge in the host region		
9.2.2	Availability of qualified human capital at a lower cost than in your own country		
9.2.3	Access to knowledge infrastructure and services in the host region (R&D infrastructure, technical support services etc.)		
9.2.4	Access to other infrastructure, cheaper production resources and services (land, inputs or unskilled labour, ICT, electricity, roads, airports, ports etc.)		
9.2.5	Opportunity to sell existing products and achieve greater access into new markets		
9.2.6	Incentives for the location of activities in the host region (e.g. favourable regulations, special tax regimes, testing facilities and trials etc.)		
9.2.7	Efficient financial markets (including Venture Capital)		
9.2.8	The level of ethical standards and trust		
9.2.9	The enforcement of intellectual property rights		
9.2.10	Following clients who are outsourcing i.e. 'follow sourcing'		
9.2.11	Other, please specify below		

Other (please specify)

10. Please indicate how the following functions are performed by your enterprise, including different subsidiaries of the same firm. Please select all that apply.

		By your unit in your location	At subsidiaries of firm in a developed location(s)	At subsidiaries of firm in a developing location(s)	Outsourced to a partner in your country	Outsourced to a partner outside your country in a developed location	Outsourced to a partner outside your country in a developing location
10.1	Strategic Management						
10.2	Product development (research, design and engineering)						
10.3	Marketing, sales and account management						
10.4	Operations (manufacturing, service supply)						
10.5	Procurement, logistics, distribution (obtaining, storing and transporting inputs and outputs)						
10.6	Corporate governance (legal, finance, accounting, government relations)						
10.7	Human resource management						
10.8	Technology and process development (maintenance, redesign of equipment)						
10.9	Firm infrastructure (building and maintenance IT systems)						
10.10	Customers and after sales service						

11. Indicate the extent to which the following factors represented a challenge or barrier when developing a new good or service in collaboration with firms, universities or other organisations located abroad?

Please note only one answer may be selected per row.

		Extreme Barrier	Serious Barrier	Moderate Barrier	Small Barrier	Not a barrier at all
11.1	Finding relevant new knowledge					
11.2	Overcoming organisational barriers and gaining management acceptance					
11.3	Changing the current location of operations and the associated cost thereof					
11.4	Managing globally dispersed projects and cultural differences					
11.5	Harmonising tools, structures and processes					

12. During the PAST three years, how did your enterprise experience the following factors in the internationalisation of your innovation activities?

		Highly Negative	Moderately Negative	Moderately Positive	Highly Positive	Factor Not Experienced
12.1	Practical support from centres for the internationalisation of innovation and technology transfer					
12.2	Public incentives and economic support					
12.3	The international exposure and contacts of universities, public research and administrative structures					
12.4	Relevant labour force training and skills					
12.5	The regulations, practice and jurisprudence around intellectual property rights					
12.6	The rules and practice regarding foreign direct investment and trade policy					
12.7	The rules and practice regarding migration policy regulations for employing foreign					

		Highly Negative	Moderately Negative	Moderately Positive	Highly Positive	Factor Not Experienced
	scientists/technicians/expert					
12.8	The availability of risk capital for innovation activities with an international dimension					
12.9	The corporate governance environment (rules concerning firm ownership, shareholder's rights, etc.)					

13. Considering your future innovation activities, please assess the need for improving the following factors:

		Very high need	Moderately high need	Moderately low need	Very low need	Factor not needed
13.1	Practical support from centres for the internationalisation of innovation and technology transfer					
13.2	More public incentives and economic support					
13.3	Better access to international research networks					
13.4	Higher skills in the labour force					
13.5	More stringent regulations, practice and jurisprudence around intellectual property rights					
13.6	Better and clearer rules regarding foreign direct investment and trade					
13.7	More open and flexible migration policy regulations for employing foreign scientists/technicians/experts					
13.8	Greater availability of risk capital for innovation activities with an international dimension					

14. How have you reacted (or are planning to react) to the current global economic crisis?

14.1	Few or no changes	
14.2	Increasing efforts at innovation on your part	
14.3	A serious reduction of your innovative activities	
14.4	Relocation abroad of your innovative activities	
14.5	Relocation of innovative activities to you from abroad	

Contact information

Company	
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Country	
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Phone number	

THANK YOU!