DETERMINANTS OF KEY SUCCESS CRITERIA IN ESTABLISHING AND SUSTAINING AN INTERNET OF THINGS (IOT) NEW TECHNOLOGY VENTURE (NTV) IN SOUTH AFRICA

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ABSTRACT

Technology entrepreneurship is vital to economic development as it could have positive effects on employment and could rejuvenate industries, especially through disruptive technologies. Studies have shown that South Africa has one of the highest new venture failure rates across the globe and it is, therefore, becoming critical to determine the key factors of successful technology ventures that could contribute to sustaining new technology ventures in South Africa.

With the Internet of Things (IoT) fast becoming the most exciting technology trend aimed at transforming everyday business and individual lives, this study set out to investigate the key success criteria for IoT new ventures, as well as key sectors for IoT within South Africa. Linking technology entrepreneurship and the opportunities provided by IoT, this research aims to identify the key success criteria of entrepreneurial ventures within South Africa, as well as analyse the South African IoT ecosystem to determine which sectors provide the greatest opportunity for technology entrepreneurs.

This research was conducted through primary research across IoT new technology ventures, as well as enterprises across industries within South Africa. The study found that successful ventures and unsuccessful ventures have different entrepreneur characteristics. A key characteristic for successful IoT ventures is entrepreneur ambitions, while education is the biggest hindrance to unsuccessful ventures. The related car and fleet management industries were found to provide the largest opportunity for IoT entrepreneurship in South Africa. This study provides valuable insight into the IoT market that will aid the sustainability of IoT entrepreneurship. From an academic perspective, it supplements the existing literature on technology and IoT entrepreneurship in South Africa.

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CHAPTER 1. INTRODUCTION

1.1 Purpose of the Study

Technology entrepreneurship is vital to economic development as it could have positive effects on employment and could rejuvenate industries, especially through disruptive technologies. Studies have shown that South Africa has one of the highest new venture failure rates across the globe (SeedCapital 2014). With 39% of new ventures failing within the first six months of establishment, it is critical to determine the key factors of successful technology ventures as this may contribute to sustaining new technology ventures in South Africa.

The Internet of Things (IoT) is currently the most exciting technology trend. It is anticipated to create a $2 trillion industry by 2019 (Pickett 2014) which means that it will transform everyday business as well as individuals lives. Gartner (2015) has reported IoT as its top technology trend for 2016 and has predicted that IoT hardware sales will amount to $2.5 million a minute in 2016 and that by 2021, 1 million IoT devices will be installed every single hour across the globe.

The purpose of this proposed study is therefore to determine the main factors that lead to the success of new technology ventures in South Africa, as well as the key sectors within which the Internet of Things pose the greatest opportunity for South African technology entrepreneurs. Understanding these success factors and key vertical sectors could potentially assist future South African entrepreneurs to adopt these qualities and focus on those verticals to enable a higher success rate and sustainability within the IoT ecosystem.

1.2 Context of the Study

The Internet of Things (IoT) is described by many industry analysts as the next digital revolution, impacting nearly every industry and consumer (Manyika et al. 2015). This socio-technical phenomena which promises to connect humans to

machines and machines to machines has the power to disrupt society in the same way the Internet did before (Gazis et al. 2015). The IoT is the connection of nearly any object, asset or machine to the Internet, which can include cars, watches, glasses, coffee machines and anything else worth tracking or monitoring. This emerging technology is growing significantly within enterprises for two reasons: 1) to create more efficiency in their operations; and 2) to satisfy consumers who want a more 'connected experience'. The emergence of this technology has shaped an exciting opportunity for enterprising technology entrepreneurs with ambitions to exploit this lucrative market which is projected to add almost $2 trillion in value to the global economy by 2019 (Pickett 2014).

This study will aim to identify the key success criteria of entrepreneurial ventures within South Africa, as well as analyse the South African IoT ecosystem to determine the sector that provides the greatest opportunity for technology entrepreneurs. By identifying and analysing both the entrepreneurial success factors and IoT ecosystem, the researcher aims to add to the existing literature on entrepreneurship by naming the key success factors of entrepreneurial ventures and also analysing the IoT ecosystem. This could assist future entrepreneurs in the adoption of IoT and also provide a focus on the most successful verticals within IoT, thus increasing the success rate within a venture.

1.3 Problem Statement

1.3.1 Main Problem

Identify the key determinants of successful technology ventures as perceived by South African enterprises and evaluate which sector is the most rewarding for successfully developing or sustaining an IoT venture in South Africa.

1.3.2 Sub-Problems

Sub problem 1

Identify the key success factors of technology entrepreneurship in South Africa.

Sub problem 2

Evaluate the key success sectors for IoT entrepreneurship within South Africa.

1.4 Significance of the Study

According to the Global Entrepreneurship Monitor (GEM 2014), South Africa's new venture failure rates rank amongst the highest in the world (Singer 2014) and, according to a survey conducted by SeedCapital in South Africa, it shows that up to 39% of these failures occur within the first six months of establishment. The main reason for these early failures as found by the survey is a 'lack of guidance' which highlights the in-experience of the entrepreneurs (SeedCapital 2014).

IoT is an emerging technology that is predicted to revolutionise our everyday lives, both personally and in business. IoT envisions for nearly every item to be connected to the Internet and therefore requires thousands of applications in every sector to enable connection of these 'things' to the Internet. This provides enormous opportunities for technology entrepreneurs across specialisation in any sector to participate in the IoT ecosystem and in building the IoT vision.

This study may assist future technology entrepreneurs within IoT to overcome the high start-up failure rate in South Africa by adapting themselves and their ventures to some of the success factors identified in the study and focusing their efforts on verticals that pose the highest opportunity.

1.5 Delimitations of the Study

- For this study, IoT new ventures constitute South African registered IoT new ventures or SMEs (Small to Medium Enterprises).
- The quantitative survey focuses on both Corporate and Small Medium Enterprises as part of this study.
- An IoT new venture may also be a customer of another IoT venture.
- The quantitative survey is directed at individuals responsible for procurement or project engagement with South African technology ventures.
- An SME IoT venture should have provided a solution or services to the respondents either currently or previously.

1.6 Definition of Terms

- **Internet of Things (IoT)** – A network of physical objects which has or can be enabled with an IP address for Internet connectivity and which can then seamlessly communicate between objects and other Internet-enabled devices and systems (Haller 2009).
- **Information and Communication Technology (ICT)** – Includes any communication device or application, as well as the various services and solutions associated with them.
- **Successful Venture** – Success is defined as the achievement of something desired, planned or attempted (Hall et al. 1993)

1.7 Assumptions

- Respondent sample is across SMEs and Corporate Enterprises, assuming their experience of a successful technology vendor will be similar.
- Respondents will reflect their normal perspectives and unbiased experiences with technology providers.
- All responses provided by respondents are accurate, factual and fully represent their perceptions of a successful technology provider.

CHAPTER 2. LITERATURE REVIEW

2.1 Introduction

As elucidated earlier in Chapter 1, the Internet of Things (IoT) is a fast growing and emerging technology that poses significant opportunities for future technology entrepreneurs (Pickett 2014). It was also highlighted earlier that South Africa has one of the highest start-up failure rates globally according to the latest GEM report (Singer 2014). This literature review aims to investigate the IoT ecosystem as a potential sector for profitable entrepreneurship in South Africa, as well as the key determinants of a successful technology venture.

The chapter starts by analysing existing literature on key success factors of new technology ventures, as well as reviewing South African literature on entrepreneurship to reveal the influences and inhibitors of entrepreneurship in South Africa that could aid the overall success rate within new technology ventures in South Africa.

The chapter then outlines the IoT ecosystems and different vertical sectors providing various IoT solutions, after which the key vertical sectors relevant in South Africa are highlighted. The review concludes by determining the relevance of these key determinants for success in an IoT start-up, as well as the key sector(s) for IoT new ventures.

2.2 IoT Entrepreneurship in South Africa

The Internet of Things' market is predicted to grow to USD 7.1trillion in revenues by 2020 according to a report by the IT research firm IDC (Spencer 2014), with over 25 billion devices being connected across various industries. The IoT solutions are made up of hardware, software, and services that are currently being used across industry verticals, servicing both consumers and enterprises. With such a broad reach across the spectrum and high revenue

potentials, this emerging technology will no doubt create lucrative opportunities for entrepreneurs or impact their existing businesses by creating efficiencies, optimising processes or creating new revenue streams.

Technology or products alone do not, however, lead to a venture success (Kakati 2003). There are multiple criterias which contribute to success, ranging from entrepreneurs characteristics, education and financial support to government policies and regulation (Herrington et al. 2009). Through the following literature review, the researcher aims to identify these key criteria with the intent to promote sustainability within new IoT technology ventures in South Africa.

2.3 Key Success Factors of New Technology Ventures

There have been many empirical studies over the years which identify the success criteria of new ventures. Studies such as those by Knight (1986), MacMillan et al. (1986) and Tyebjee and Bruno (1984), have all investigated and identified criteria used by venture capitalists to evaluate SME performance. Other studies by, for example, Roure and Maidique (1986) and Stuart and Abetti (1987) have analysed the key determinants of performance in high-tech industries while studies by Chandler and Hanks (1994), Kakati (1999) and Mahoney et al. (1992) have all looked at success factors in low-tech industries.

In more recent research, a number of academics have also evaluated success factors in new ventures. As with the earlier studies, most of the research has been focused purely on entrepreneurial venture success criteria as perceived by venture capitalist or angel investors (Dhochak & Sharma 2014; Forrester 2014; Hall & Hofer 1993; Zacharakis & Meyer 1995; Zacharakis & Shepherd 2007.

Although these studies analysed success criteria for financial investments in equity gain, they did provide valuable insights into the success criteria of new

technology ventures. The models used to measure success across these studies differed across the years, although they all revolved around entrepreneur characteristics, market acceptance, size of product or technology, competition in field of venture, the ventures competitive strategies adopted and financial standing of the venture.

MacMillan et al. (1986) posits that essential criteria to be measured when analysing success criteria should include four key areas, namely entrepreneur characteristics, product characteristics, market characteristics and financial consideration. Kakati (2003) adds that when analysing success criteria in high-tech ventures, it is essential to also include two important determinants that are often ignored, namely competitive strategy and resource based capability.

Kakati (2003) studied the success criteria in new technology ventures and used a combination of the above models. Thus, while Kakati used the approach of MacMillan et al. (1986) which consisted of the four abovementioned groupings (entrepreneur characteristics, product characteristics, market characteristics and financial consideration), he also included competitive strategy and resource based capability, thus creating a 38 criteria scale in six groupings.

Based on the existing literature, the Kakati model is the most comprehensive for evaluating the success criteria of a high technology entrepreneurial venture.

2.3.1 Entrepreneur Characteristics

A recurring criterion among all the studies is entrepreneur characteristics, with an emphasis on entrepreneur ambitions (Dhochak & Sharma 2014; Hall et al. 1993; Kakati 2003) and, as such, this study will aim to explicate this key criterion in further detail.

It has been posited by various scholars and researchers that entrepreneurs have unique characteristics which may differ from non-entrepreneurs

(Ciavarella et al. 2004; Van Ness & Seifert 2015). Many of these scholars believe that the main differences can be found in the personality of the entrepreneur; thus, successful entrepreneurs tend to be more optimistic, have a higher risk-taking propensity, are more conscientious and have a higher locus of control (Chye Koh 1996). But while earlier studies have tended to focus only on personality, Van Ness and Seifert (2015) highlight in their study that it is crucial to include a multi-dimensional approach, including 'work ethic' and 'affect'.

Affect relates to moods, perceptions, cognitive processes, etc. It has been suggested by the existing research that entrepreneurs generally have more positive moods as entrepreneurs are assumed to be more optimistic about opportunities and ideas. Positive affect is generally associated with 'increased energy enhanced cognitive flexibility, greater confidence, better decision making strategies etc.' This is thus an important characteristic of an entrepreneur (Baron et al. 2011).

Work ethic is also another crucial characteristic of an entrepreneur as it displays the degree of value the entrepreneur places on work diligence and efficiency (Weber 2002). After reviewing a series of empirical studies, Miller et al. (2002) created a model for measuring work ethic. This Multidimensional Work Ethic Profile (MWEP) consists of 65 items that measure seven distinct facets of work ethic construct. These seven dimensions include work centrality, wasted time, self-reliance, delay of gratification, hard work, morality / ethics and leisure. Of these seven dimensions, three are very relevant to entrepreneurs. These three include work centrality, self-reliance and delay in gratification (Van Ness & Seifert 2015).

Work centrality is important to entrepreneurs as it highlights the entrepreneur's commitment to his / her venture by investing personal time, capital and reputation. A primary motivator for many entrepreneurs is the ability to be self-reliant, act autonomously and be free from authority (Kolveried 1996). Delay in

gratification refers to the entrepreneur's ability to invest in his venture from the outset while relinquishing short-term rewards for greater long-term rewards. This delay in gratification is brought about by a unique characteristic of strong willingness within entrepreneurs (Van Ness & Seifert 2015).

In the Kakati (2003) model, two key measures within the entrepreneurial characteristics criteria, namely 'desire for success' and 'capacity for work', relate to affect and work centrality respectively. For the purposes of this study these two measures combined can be regarded as entrepreneurial ambitions.

2.3.2 Entrepreneurship in South Africa

Various studies on entrepreneurship success have been conducted in South Africa, although the research has mainly focused on obstacles and barriers to starting a business, or on entrepreneurial orientation. Hardly any of the studies investigated new venture technology entrepreneurship. The table below is a consolidated view of some of the South African related literature.

Authors	Topic
Van Vuuren and Groenwald (2007)	A critical analysis of the influence of start-up factors in small businesses and entrepreneurial ventures in South Africa.
Naude (2004)	Establish the factors that inhibit entrepreneurship in South Africa.
Jesselyn and Mitchell (2004)	Comparative analysis of perceived obstacles to entrepreneurship.
Van Vuuren (2003)	The contribution of support and incentive programs to entrepreneurial orientation and start-up culture in South Africa.
Jesselyn (2003)	Analysis of the formal institutional factors affecting entrepreneurship in a developing country: Lessons for Africa.
Verhoeven (2001)	Factors influencing profitable growth in small and medium-sized businesses.
Radipere et al. (2014)	The role of gender and education on small business performance in the South African Small Enterprise Sector.

Table 1: Consolidated view on some of the academic research on entrepreneurial success factors and inhibitors

Van Vuuren's (2007) study focuses on key factors that influence start-up activity in Gauteng, a province in South Africa. The objective of the study was to uncover these factors through primary research in Gauteng, which could then empower potential entrepreneurs to consider these factors before starting their entrepreneurial journey within the city. The study, which comprised of personal interviews with 312 respondents, found that personal management and involvement, role models, effective time management, and support from partners and advisors were the four key factors that influence start-up ventures in Gauteng. While the Van Vuuren study was effective in identifying key factors which could influence the entrepreneurial journey, it remained limited to the influencing factors and did not investigate the factors which led to the success of the entrepreneur or entrepreneurial venture. Also, this study focused solely on key influencing factors to entrepreneurship in the Gauteng region, whereas studies by Jesselyn (2003), Jesselyn and Mitchell (2004) and Naude (2004) all focused on factors which inhibit or create obstacles and thus prevent entrepreneurship in South Africa. Both the Jesselyn (2003) and Jesselyn and Mitchell (2004) studies focus mainly on policy and obstacles or lack of support provided by governmental institutions to cultivate entrepreneurship in South Africa. Naude's (2004) study included government regulation and bureaucracy as a perceived inhibitor but also extended to other inhibiting factors, which included educational systems, lack of start-up capital, discrimination and lack of business knowledge. The findings from the abovementioned studies concur with the analysis of the GEM report on main inhibitors of entrepreneurial activity in South Africa (Herrington et al. 2009). This study is an analysis of the key finding and insights of GEM reports from 2001 until 2009.

	2002	2008
• Inadequately educated workforce	1 (21%)	2 (16%)
• Crime and theft	2 (19%)	1 (19%)
• Restrictive labour regulations	3 (17%)	4 (12%)
• Poor work ethic in national labour force	4 (10%)	7 (5%)
• Inefficient government bureaucracy	5 (7%)	3 (14%)
• Access to financing	6 (6%)	5 (9%)
• Corruption	10 (2%)	6 (7%)
• Inadequate supply of infrastructure	13 (2%)	8 (4%)

Table 2: Most problematic areas for doing business in South Africa, 2002 versus 2008

Table 2 highlights the major inhibitors for doing business in South Africa by comparing 2002 against 2008, which clearly shows that access to financing is not the main inhibitor but rather crime, education and inefficient government bureaucracy.

Based on this in-depth analysis of insights over the years, the study highlighted that the main inhibitors of entrepreneurial activity in South Africa is the education system, social and cultural norms, financial support and government regulations and policies (Herrington et al. 2009).

Education

As acknowledged in the 2001 GEM report, past apartheid policies on education deeply impacted a majority of the population's confidence and self-esteem which, in turn, hampers their initiative and creative thinking. The apartheid restrictions limited access to formal education, as well as informal learning and work experience, which are all essential for developing the skills and confidence to begin an entrepreneurial journey.

Since the end of apartheid, access to schooling and education has become more widespread across the population, although the South African education system is still not as effective as other developing countries, such as Uganda, Argentina, Brazil, Chile and China, for developing the skills required for entrepreneurship. This is clearly indicated in the table below which shows how the 2005 GEM report analysed the participating developing countries' educational systems and the extent to which they prepared learners with skills for entrepreneurship. It also shows that South African adults with basic schooling and no tertiary education were significantly less able to sustain a new business venture than counterparts in other developing countries (Herrington et al. 2009). The report did, however, confirm that South Africans with tertiary education were as able as counterparts to sustain a new venture, thus highlighting that South African tertiary education was comparable and the lack is mainly in the schooling education system.

	Not completed secondary schooling (%)	Completed secondary schooling (%)	Tertiary education (%)
South Africa	0.1	1.0	4.3
Argentina	2.3	6.6[3]	7.9
Brazil	4.0[3]	5.2[3]	6.3
Chile	4.0[3]	3.4	6.5
China	2.5[3]	4.7[3]	5.1
Uganda	7.4[3]	12.9[3]	12.0

Table 3: Opportunity-motivated new firm activity rates among young adults by highest educational attainment

Throughout the GEM reports included in this study, the key informants have consistently highlighted education and training as being the top three inhibitors to entrepreneurship in South Africa.

Cultural and Social Norms

The study highlighted that entrepreneurship is not seen as a legitimate or desired career choice within South Africa as compared to corporate or public sector employment. There is hardly any entrepreneur role model and not enough exposure is given to local entrepreneurs as is done for sporting heroes, for example (Herrington et al. 2009). Throughout the empirical research on entrepreneurship, role model, support from partners, advisors and community are critical for increasing entrepreneurial activity, as well as contributing to the success of entrepreneurial ventures.

Financial and Business Support

Financial and business support is another regular inhibitor to entrepreneurship in South Africa among the many studies (e.g. Herrington et al. 2009; Naude 2004; Van Vuuren 2007; Verhoeven 2001). The GEM study puts forth that a primary reason for this in South Africa is that there is a lack of communication between financial institutions and entrepreneurs, where financial institutions are unable to understand or interact with entrepreneurs and entrepreneurs are unable to present well-researched business ideas with aptly backed business plans (Herrington et al. 2009). Banks, unlike venture capitalist, angel investors, etc., are not primarily interested in a venture's future prospects but are, rather, concerned about the entrepreneurs' ability to repay the loan as they are the

custodians of their clienteles' money and are obligated to provide a return on investment for their clients' investments.

The government has created numerous initiatives to provide funding to entrepreneurs and SMMEs since 1994, trying to integrate SMMEs into the national economy to create wealth and influence job creation as well as skills development, especially among black entrepreneurs (DTI 2008). Many of these government-backed institutions are, however, found to be inefficient and do not have the best interests of entrepreneurs at heart as they are controlled by political appointees (Herrington et al. 2009). An SME survey conducted across South Africa also found that government initiatives to promote entrepreneurship and SMME development have not been very successful, with many respondents unaware of the various institutions and many not willing to use the services they are aware of (Goldstruck 2004). The table below highlights the low awareness and low usage of these government backed institutions.

	Heard of	Used
SETAs	61%	32%
Competitiveness Fund	32%	11%
Industrial Development Corporation	45%	7%
Export Incentives	12%	2%
Manufacturing Advisory Centres	11%	1%
Ntsika Promotion Agency	13%	1%
Khula Enterprise Finance	9%	1%
Brain	9%	1%
Umsobomvu Youth Fund	4%	1%

Table 4: Government business support institutions awareness and use in 2004 (Source: SME survey 2004, Goldstruck)

	Gauteng	KwaZulu-Natal	Western Cape
UYF: heard	57.3%	51.0%	23.4%
UYF: used	11.7%	1.6%	1.3%
KEF: heard	14.0%	8.1%	9.2%
KEF: used	0.8%	0%	0.3%
SEDA: heard	13.5%	6.5%	10.0%
SEDA: used	1.3%	0.2%	0.5%
IDC: heard	8.5%	4.7%	4.1%
IDC: used	1.0%	0%	0.3%
NEF: heard	10.9%	4.5%	6.6%
NEF: used	1.3%	0.2%	0.3%
Other: heard	1.0%	2.0%	1.7%
Other: used	0.8%	0%	0.5%

Table 5: Government business support institutions awareness and use in 2004 (Source: GEM report 2007)

The Regulatory Environment and Government Policies

Many empirical studies suggest that a regulatory environment and government policies have a major influence on business sustainability and growth (Thurik & Wennekers 2004). A study has shown that compliance cost for business with less than a 1 million rand turnover represents 8.3% of total turnover and up to 0.2% for annual turnover for a business with 1 billion rand or more. These amounts equated to 6.5% of the South African GDP (Gross Domestic Product) in 2004 (SBP 2009). These costs are excessive and can lead to severe constraints on business growth in South Africa.

South Africa was recently ranked as 73rd out of 189 economies for 'ease of doing business 2016' by the World Bank Group. South Africa's position in the global ranking has decreased by 4 positions since 2015 (Bank 2015). Doing Business analyses the ease or difficulty of doing business in 189 economies globally across 10 areas when complying with country regulations and policies. South Africa's decrease in ranking from 2015 to 2016 is primarily attributed to the ongoing electricity crisis encountered throughout 2015. The diagram below (Figure 1) displays South Africa's overall ranking in each of the areas.

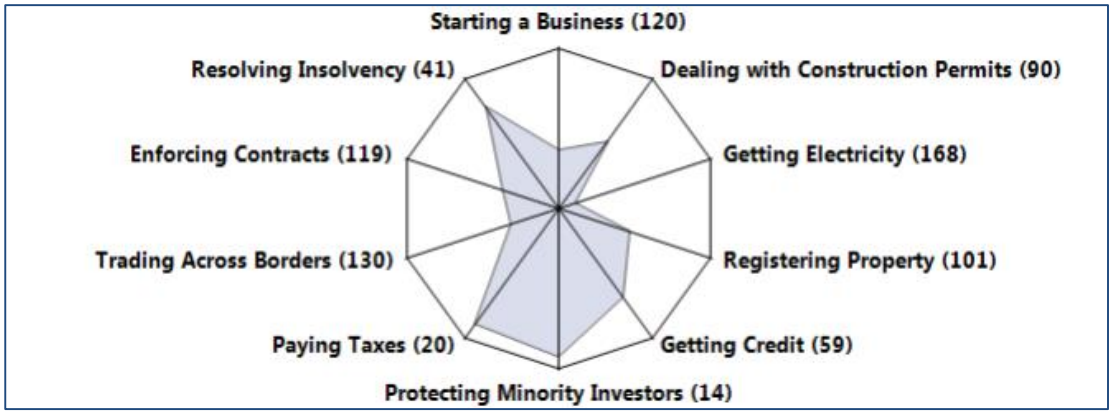

Figure 1: Doing Business's ranking of South Africa

The Global Competitiveness Index 2015 ranked South Africa as 56 out of 144 countries with health and education (132) and labour market efficiency (113) as the largest hindrance to overall ranking. Labour market efficiency, which is

associated with inflexible hiring or firing practices, inflexibility of remuneration by companies and lack of positive relations between employer and employee, all negatively impact South Africa's ability to compete globally. It has been argued by Bosma and Levie (2009) that strict employee protection policies hamper business growth and that if these protection laws were to be relaxed, it could be more rewarding for both employees and businesses.

2.4 Internet of Things

As defined earlier, the Internet of Things refers to the network of physical objects which can seamlessly communicate with and between each other and other Internet-enabled devices and systems. By enabling these objects to 'communicate', they can acquire valuable data through sensors, which can then be passed onto backend systems for analysis, and further execution, for example if the temperature is higher than 35 degrees Celsius, an engine could be commanded to switch off automatically.

The application of IoT is very simple. Various sensors or probes, such as cameras, accelerometers, GPS modules, and so on, are attached to the objects or assets which need to be monitored. These sensors then collect the required information / data from the assets and its surroundings and, via a communication module, reports the data back to a server which will then analyse it for reporting and action (Boman & Aubertin 2014). The value of IoT is that the data which is acquired enables businesses to improve their offerings and optimise processes to create efficiencies.

Various industries have, for many years already, experienced the benefits of IoT through tracking, monitoring, mobile applications and other connected devices even though the market is still at an early stage in its development. The market is, however, in the midst of rapid expansion and will reach its true potential when more and more devices, assets and objects become connected to the Internet and with each other. With the decrease in cost of sensors in

recent years, data tariffs from mobile operators have increasingly become optimised and the availability of big data analytics tools is set to rise to the tens of billions range of connected devices.

There is abundant opportunities for technology entrepreneurs to profit from IoT and it is expected that creative entrepreneurs will drive progress in this sector. New start-up entrepreneurs are much more agile than larger businesses and corporations, and thus have more freedom to innovate and invent at a larger scale and quicker pace to create the next breakthrough device or solution that will be consumed by the industry. As the IoT industry is still so new, those breakthrough offerings will tend to get noticed easily and therefore rapidly rise to success within the industry (Pickett 2014).

2.4.1 The Internet Before 'Things'

The Internet has already drastically transformed everyday lives across the globe, from the way we communicate, socialise, and shop, to the way we learn and conduct business. This revolutionary technology is currently being used by over 3.2 billion people across the globe, has increased GDP in mature countries by up to 21% over the past five years, and has transacted in excess of $8 trillion every year through e-commerce and yet we are still in the infancy stage of the transformations the Internet can deliver to our daily lives (Manyika & Roxburgh 2011). Research by the McKinsey Global Institute in 2011 shows that, of leading economies which amasses 70% of the global GDP, the Internet on average provides 3.4% of GDP per economy, which is larger than the average GDP of agriculture or utilities as depicted in Figure 2.

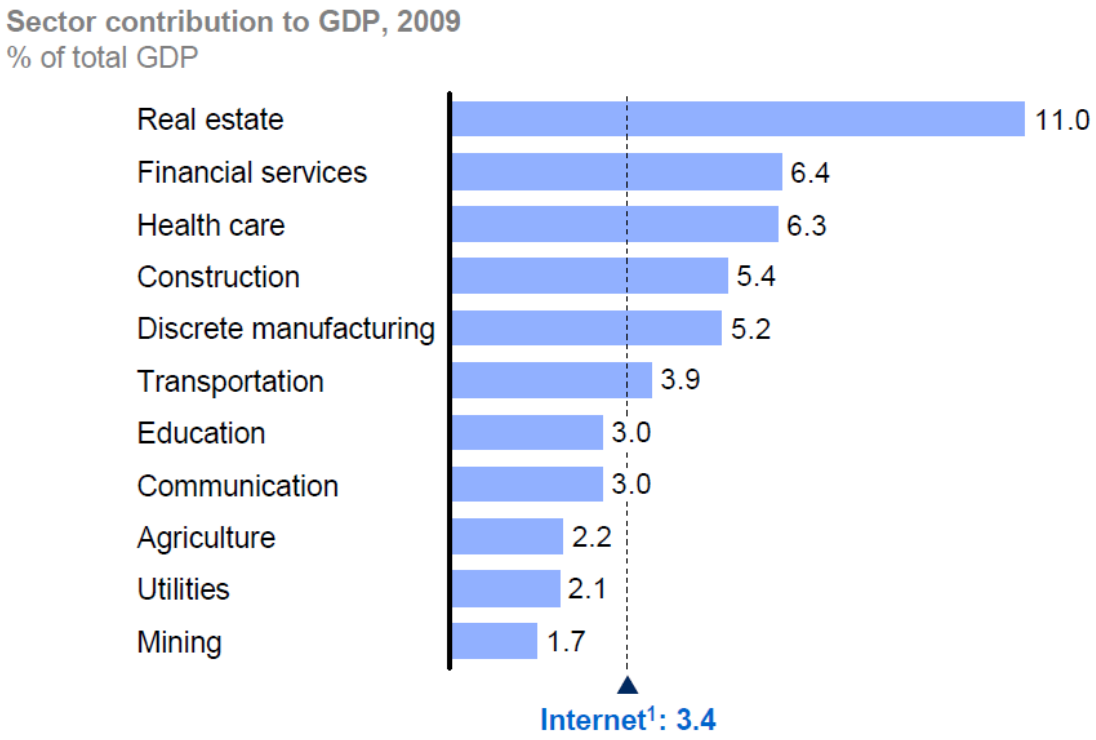

Figure 2: Weight of Internet towards GDP as compared by sector

While many corporate and larger enterprises have benefited tremendously from the Internet, amongst the biggest beneficiaries has been new venture and entrepreneurs (Manyika & Roxburgh 2011). The Internet has enabled new ventures to emerge as 'born globals' by allowing them to easily compete with large corporations through accessing or retailing products across the globe, acquiring talent easily and providing broad marketing reach rapidly. Expanding on the Internet, the IoT is posited by many academics, analysts and industry leaders as being the third industrial revolution which will accelerate advances in business as did the first and second industrial revolutions of mechanical and mass production respectively (Dohler et al. 2013; Ma 2011; Trappeniers et al. 2013).

2.4.2 IoT Ecosystem

The IoT ecosystem consists of vendors, which specialise in IoT hardware or software, telecommunication providers, system integrators and a growing number of commercial and consumer users. By analysing 300 IoT applications, the McKinsey Global Institute has identified nine settings which IoT will have the greatest impact on. These settings highlight the industries which IoT will be adopted by the fastest, therefore creating the largest revenue opportunities (Manyika et al. 2015). These nine settings will thus attract various entrepreneurs who will endeavour to capitalise on these identified sectors.

A "settings" lens helps capture all sources of value; we identify nine settings where IoT creates value

Setting		Description	Examples
	Human	Devices attached to or inside the human body	Devices (wearables and ingestibles) to monitor and maintain human health and wellness; disease management, increased fitness, higher productivity
	Home	Buildings where people live	Home controllers and security systems
	Retail environments	Spaces where consumers engage in commerce	Stores, banks, restaurants, arenas—anywhere consumers consider and buy; self-checkout, in-store offers, inventory optimization
	Offices	Spaces where knowledge workers work	Energy management and security in office buildings; improved productivity, including for mobile employees
	Factories	Standardized production environments	Places with repetitive work routines, including hospitals and farms; operating efficiencies, optimizing equipment use and inventory
	Worksites	Custom production environments	Mining, oil and gas, construction; operating efficiencies, predictive maintenance, health and safety
	Vehicles	Systems inside moving vehicles	Vehicles including cars, trucks, ships, aircraft, and trains; condition-based maintenance, usage-based design, pre-sales analytics
	Cities	Urban environments	Public spaces and infrastructure in urban settings; adaptive traffic control, smart meters, environmental monitoring, resource management
	Outside	Between urban environments (and outside other settings)	Outside uses include railroad tracks, autonomous vehicles (outside urban locations), and flight navigation; real-time routing, connected navigation, shipment tracking

SOURCE: McKinsey Global Institute analysis

Figure 3: Nine settings where IoT creates value

The *Harvard Business Review* has grouped the above sectors into five key categories, namely connected consumers, connected cars, connected homes, connected cities and the industrial Internet (Simona 2014). Literature suggests that the Connected Car grouping currently provides the largest revenue

opportunity, although this is mainly prevalent in the European and American markets where many of the vehicle OEMs are headquartered. In other consumers markets, the Connected Wearables grouping is providing the most lucrative opportunities with highest revenues being generated (Manyika et al. 2015).

New technology venture entrepreneurs in these verticals are using the IoT to pioneer new products and solutions that will generate efficiencies in enterprises' operations or the day-to-day lives of consumers. IoT is also being used to create new revenue streams for some customers' existing products. Mckinsey's used a bottom-up approach for identifying the sectors which will provide the greatest impact on the Internet of Things. Their analyses looked at the impact throughout the value chain, which consists of enterprises, consumers, suppliers and the government sector. They also investigated a wide range of application types where IoT will be used, e.g. operations, sales enablement, safety and security, and product development.

Based on Mckinsey's analysis, it was estimated that the economic impact of IoT applications could range from $3.9 trillion to $11.1 trillion per year in 2025. Of the nine highlighted settings, they estimate that factories are likely to have the greatest potential impact from IoT use (Figure 4). The next largest setting in terms of potential impact would be cities, where IoT applications have the potential for an impact of as much as $1.7 trillion per year in 2025.

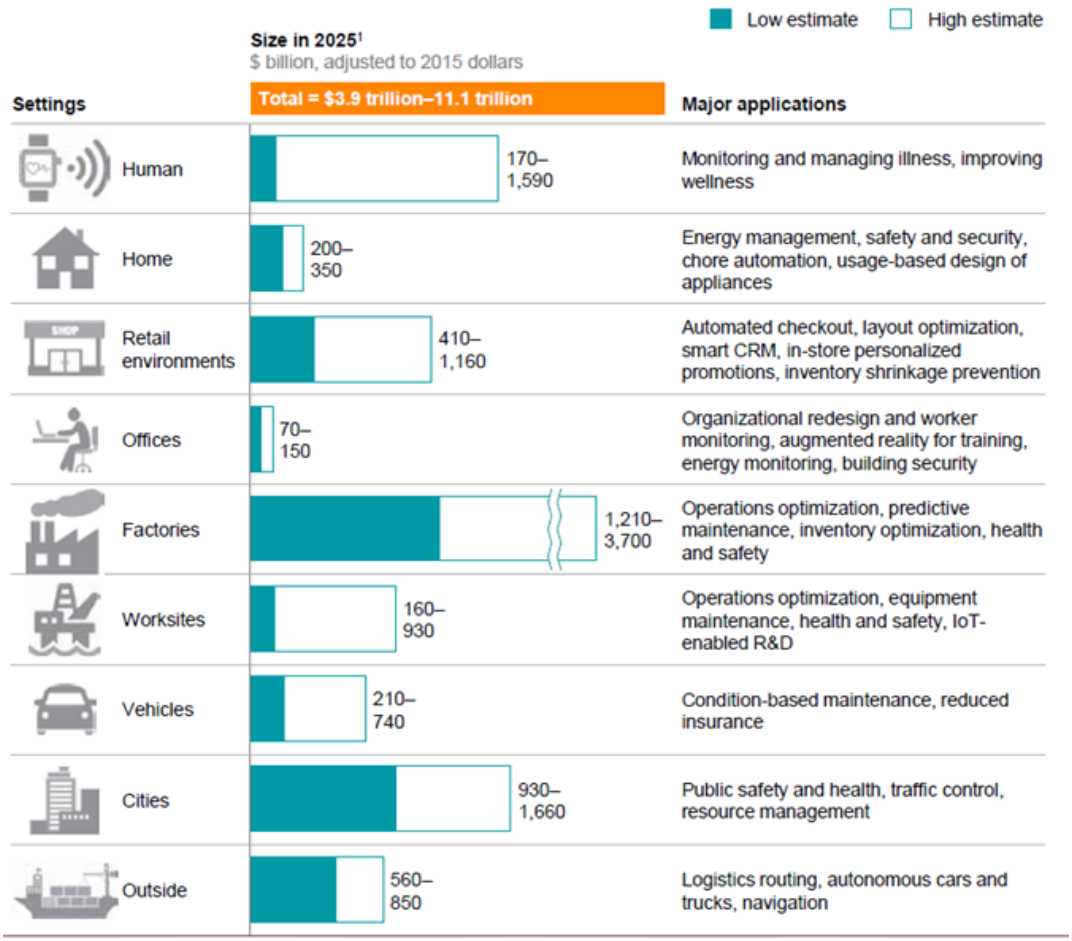

Figure 4: Potential economic impact of IoT by 2025

2.4.3 Opportunities for IoT Entrepreneurship

From the abundant reports and analyses, it is clear that IoT continues to be a rapidly growing market, which traverses industries, businesses and consumers. Businesses are adopting IoT technologies that provide them with ample data to create efficiencies within their operations and transform their existing business processes, thus leading to a positive impact on revenues. Consumers are aware of the innovation brought about by IoT, for example the connected car, connected home, and connected wearables that transform their daily lives. The International Data Corporation, a leading ICT firm, sees IoT as a huge opportunity for SMEs as larger corporations are looking at smaller innovative entrepreneurs and SMEs for swift developments and supply in this market. IDC believes that SMEs and entrepreneurs need to partner with other entrepreneurs

and corporations to prosper in this market (Lund et al. 2014). Ventureburn recently reported that the crux of IoT is the data, which is being generated through the various technologies and speculate that emerging economies are set to benefit the most because of its scarcity of data. They added that this emerging technology can be used to solve some of the challenges faced in South Africa and across the African continent, especially within the health, retail and agricultural sectors (Coetzee 2015).

In Paco Maroto's IoT blog, he mentions that some of the crucial decisions IoT startup's need to make in order to be successful is to either be extremely bold and emulate the likes of Apple, or to be completely opposite and follow the path of Micron.

Secondly it is suggested that the entrepreneur should consider if the startup wants to control the customer experience and relationship which can potentially lead to increased revenue per customer and recurring subscription opportunities.

Alliances is a key consideration in this competitive world. You must expect that large industrial conglomerates or IT Big Vendors that have been around for decades will fight to avoid their fast food chain going to switch suppliers because a new, untested entrant from any Silicon Valley in the world has come up with a new cloud based product or service. The opportunity to disrupt the supply chain is nil if you do not play your cards smartly.

IoT in the Healthcare Sector

In South Africa, where health is a major issue because of the prevalence of chronic illnesses such as Malaria, HIV, TB, etc., the use of IoT technologies by medical practitioners and authorities can remotely monitor a patient's condition through wearable technologies. Through these sensors, which are placed on the patients, data is frequently sent to a server within the hospital and can reduce response times through an alert sent immediately to the medical practitioner should a patient's condition deteriorate (Dlodlo 2013).

Government authorities in South Africa have made strong commitments to improve healthcare for the masses and have already begun initiatives like the National Health Insurance System, although a major challenge in South Africa is still the limited amount of healthcare professionals required to serve the masses. IoT technologies will enable the limited healthcare professionals to monitor many more patients simultaneously even though the patients are not necessarily physically present.

IoT in the Retail Sector

The retail sector is one of the more mature sectors in IoT adoption and is driven by the demand from its consumers for a more efficient and connected experience while shopping. IoT solutions can vary from creating efficiencies within retail stores, for example monitoring the temperature of fridges to avoid spoilt stock, to camera surveillance and better, more targeted engagement with consumers (Coetzee 2015).

IoT in Agricultural Sector

Agriculture is major concern in South Africa and faces significant challenges which include radical climate change, lack of rainfall, lack of skilled labour, and theft of produce, equipment and cattle, as well many other societal concerns in animal welfare and environmental impact (Jayaraman et al. 2015). By adopting IoT in agriculture, farmers can address some of these challenges by remotely monitoring crops, assets and livestock, as well proactively analysing the environmental conditions for early warnings on droughts, floods and other severe weather conditions, which may impact crops.

Smart agriculture is quickly becoming the new buzz word in this sector, with farmers keen to adopt technology to increase productivity and create efficiencies with its scarce resources (Coetzee 2015). As the requirements of this sector are so varied, and depends on each particular farmer's challenges and requirements, this provides a strong opportunity for entrepreneurs to adapt solutions speedily to meet the custom requirements of farmers.

IoT in the Automotive Sector

One of the key industries in South Africa's economy is the automotive industry with many vehicle manufacturers using South Africa as a hub to source components, but also to manufacture and assemble certain vehicle ranges for both the local and international markets. The automotive industry, which accounts for 12% of the manufacturing sector, is the largest contributor to manufacturing exports from South Africa and provides an overall 7.2% towards the total GDP (DTI 2015).

Apart from manufacturing, a sizeable portion within this industry is vehicle telematics, which consists of fleet management and stolen vehicle recovery. Telematics is considered an IoT solution as it comprises a wireless device embedded in the vehicle which then records location through GPS positioning, as well as more recently collecting data on driver behaviour, such as speeding, harsh braking, harsh steering, and so on. Due to South Africa's high crime rate and the insistence of telematics devices being installed by motor insurers, South Africa is now one of the largest and more advanced markets within telematics (Mollink 2014).

Telematics in South Africa has advanced over the past number of years in terms of IoT and is no longer merely about tracking vehicles. Telematics, through IoT, now enables fleet owners to monitor driver behaviour as well as the actual vehicle and cargo being carried. As highlighted in the innovation groups report, drivers are the single biggest vulnerability to fleet owners in South Africa, with drunk driving and speeding reported to be one of the worst in the world. Accident claims amounts to more than double of vehicle theft claims in South Africa, highlighting the need for driver training and monitoring (Mollink 2014). These high volumes of accident claims has led the motor insurance industry to adapt its offerings in an effort to reduce vehicle accidents and the resulting claims by rewarding better driving through incentives to fleet owners and drivers (ArriveAlive 2015). In a recent survey conducted in the UK, the Consumer Intelligence Agency found that, of the 1500 UK motorist

surveyed, 74% of the respondents opted to have their driving monitored by motor insurance companies if their premiums would be reduced due to better driving behaviour (Mollink 2014).

According to Berg Insight, the fleet management market in South Africa is in a growth period and will continue to rise for years to come. They predict that this market will grow at a rate of 10.8% annually up to 1.5 million installations by 2020, which equates to a 32% penetration of non-privately owned vehicles (Insight 2015). The fleet management market in South Africa is dominated by local providers, such as Mix Telematics, Ctrack, Altech Netstar and Digicore. This has meant that foreign telematics providers have not been able to gain much of the market share in the country (Insight 2015). Many of these local providers are now expanding operations in international markets, either through a partner network, acquisitions or directly. The most successful South African venture in this sector has been Mix Telematics which was founded in 2006 and is now operating in 120 countries and listed on the New York Stock Exchange (NYSE). The company boasts over 1 billion rands in revenue and tracks over 500,000 vehicles globally (Smith 2013).

a) Connected Car

Advances in innovation within telematics has led to the emergence of the ‘connected car’ which integrates data collected from the vehicle, driver behaviour and the environment to provide the driver, fleet owner, insurance provider, vehicle reseller and vehicle manufacturer with real-time analysis. This information aims to increase safety, the reduction in theft, a reduction in poor driving habits and accidents, but also serves as a proactive approach from vehicle service providers in terms of maintenance and breakdowns (Swan 2015).

The connected car market is set to experience tremendous growth, mainly due to legislations within Europe, Asia and the Americas, such as eCall and Glonas legislations, which require that all new vehicles must have embedded

communication devices installed during manufacturing (Seidl et al. 2015). The primary objective of these legislations is to reduce road casualties and providing quicker responses by emergency services to road accidents. In European countries that fall within the eCall legislation, these vehicles will be able to autonomously call emergency services across Europe when involved in an accident. Based on the impact of the vehicle, an accelerometer will measure the impact size and immediately feed that data for analysis. Within seconds the data can be analysed and the severity of the impact can be determined. Based on this analysis, emergency services will be notified and provided with the location of the vehicle, the direction of travelling and time of the incident (European Commission 2015). There has been several studies conducted by academics on the benefits of autonomous emergency notification triggers towards a reduction in casualties (Bahouth et al. 2014; Seekins et al. 2013; Wu et al. 2013).

b) Opportunity for Entrepreneurs – Connected Car

While the primary reason of the eCall and Glonas legislations is safety, these initiatives have stimulated innovation within the automotive industry by using the data in other sectors (Walker et al. 201). Access to this data will create new business models and enable greater service offerings on existing solutions from innovative entrepreneurs and existing businesses. Many industries already benefit from this using this data, including insurance, retail, auto repair, marketing and city planning. By connecting vehicles connecting to the Internet, information regarding location, speed, fuel levels, vehicle performance, music selection, etc. is provided in real-time. This information, combined with other consumer data, allows for targeted marketing and innovative offerings tailored according to unique customer habits and requirements (Kavis 2015). As shown in Figure 5 below (Richard Viereckl 2014), PWC has recently categorised the connected car opportunities into six segments. These are Mobility Management, Safety, Vehicle Management, Driver Assistance, and Entertainment and Well-being. The report also expects the connected car

market to quadruple within the next five years, led by driver assistance and safety technologies (Richard Viereckl 2014)

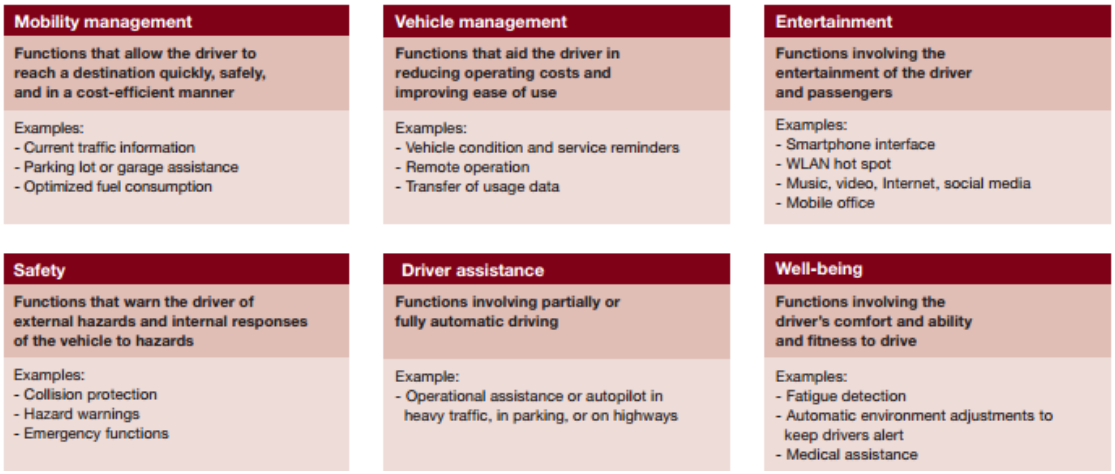

Figure 5: PWC view of connected car opportunities

2.4.4 IoT Challenges and Barriers to Adoption

As evident from the literature review, IoT offers enormous potential for the individual, businesses and society at large. Through the connection of billions or trillions of humans, machines and assets, IoT can potentially unlock a great deal of value through the acquired data. The data, in turn, can enable predictability, automation, customisation on unique needs, etc., which will lead to efficiencies, process optimisation and, in some cases, new revenue streams. While the opportunities and benefits are vast, the IoT technologies will, like many evolving technologies, encounter various challenges and barriers to adoption. Below are some of the key challenges and implications of IoT:

Security

A key concern for many Chief Information Officers (CIOs) is security which can be compromised by allowing the many external machines that are connected to the Internet to then connect to the company's infrastructure. Because IoT extends the Internet to machines and assets, and uses sensors which can be placed on nearly any object, it allows for an enormous amount of connections to the Internet, but these connections pose a threat to confidentiality and the

integrity of data, and raises privacy concerns (Weber 2010). It is essential to ensure that this data, which may contain sensitive information (e.g. healthcare, etc.), is secured through encryption methods.

Privacy

At its core, IoT solutions are based on acquiring data from assets, including humans. Connected cars, smart homes, assisted living, etc. all require personal information about an individual's living patterns and behaviour to be collected and transported to various applications for analysis. If access to this data is stolen, this could lead to a major breach of personal information. As a result, there are a number of social and political concerns which may hinder adoption (Kocher 2014).

Standardization of Protocols

As IoT spans across sectors, machines and sensors, there will be some complexity involved in integrating all the various propriety protocols to the Internet. As there are no standards defined as yet, IoT solution providers will need to get access from machine or device manufacturers in order to obtain access to the data. The integration of the various machines and assets to enable seamless communication between each other will no doubt slow down the adoption of a true IoT ecosystem (Vermesan & Friess 2013).

Existing Use Cases

While there will be many early adopter companies which will embrace IoT solutions, mainstream businesses will require concrete use cases with proven ROI models before they adopt new technologies (Kocher 2014). This will hinder the pace of IoT adoption and may reduce the value of the entire solution for eager entrepreneurs wanting quicker adoption without many proven case studies.

Apart from the above key adoption challenges, there will be many additional technical challenges faced by entrepreneurs in developing secure and reliable solutions, for example device size, battery longevity, network latency, integration, etc.

Considering the above listed challenges, Kocher (2014) suggests that potential entrepreneurs should avoid the 'technology trap' by spending too much time and money on technology development and should, rather, develop use cases and obtain customer feedback prior to investing in the technologies. He also suggests that entrepreneurs should be flexible in their technology developments and ensure that the devices are able to adapt to the different protocols and standards being developed for integration. In countering the large concerns on privacy and trust, Kocher recommends that entrepreneurs seek out partnerships with larger technology providers which will provide them with experience, resources, distribution channels and, most importantly, credibility. He concludes by advising entrepreneurs to plan for the slow adoption of their products and to ensure sufficient funding to counter any delays in revenue generation through slow adoption (Kocher 2014).

2.5 Conclusions

While there are sufficient studies highlighting the key influencing factors, as well as key inhibitors to entrepreneurship, in South Africa, there are not many studies which interrogate the key factors leading to the success of ventures, particularly new technology ventures. In the empirical studies that do analyse success criteria in technology ventures, there are certain commonalities in terms of the measurements which generally concentrate on the entrepreneur, the strategy and the product. Of the measurement models reviewed, the Kakati (2003) model seems to provide the most concise measuring criteria and caters for both high-tech and low-tech ventures. This study therefore follows this model in evaluating the key criteria for new technology ventures in South African. The study will analyse five of the groupings, namely entrepreneur

characteristics, product characteristics, market characteristics, resource-based capability and, finally, competitive strategy.

While it is clear from the literature that entrepreneurs do possess certain key characteristics which differ from non-entrepreneurs, studies do not divulge weather these characteristics differ within successful and non-successful ventures, but merely demonstrates which characteristics lead individuals to become entrepreneurs. It is therefore, based on the existing literature, theorised in this study that all entrepreneurs, weather successful or non-successful, will have similar characteristics, and that it is these characteristics, which affects personality, affect and work ethic, that enables and empowers them to begin the journey of entrepreneurship. The literature also suggests that entrepreneurial ambitions, which include affect and work centrality, are two key criteria which could lead to success. In the model we will use in this study, these two key criteria can be measured by 'desire for success' and 'enthusiasm / capacity for work'.

Among the various studies on and analyses of inhibitors to entrepreneurship in South Africa, education is at the forefront. According to the GEM report, lack of education has a direct negative impact on confidence and self-esteem, and also negatively affects creativity within a venture. Moreover, the report reveals that many South Africans have not been afforded practical work experience in their chosen fields due to education and work restrictions placed by the apartheid regime. The researcher therefore suggests that lack of education is a key inhibitor to the success of new IoT ventures.

It is clear from the literature that IoT will revolutionise society and will, no doubt, have an impact on South African businesses and consumers. IoT opportunities traverse the industry sectors and provide ample opportunities for entrepreneurs in this emerging field. While there are opportunities for entrepreneurship in nearly every sector, the literature shows that the automotive sector is one of the most developed IoT sectors within South Africa and that this has led to an

extension into global markets. The literature furthermore shows that South African fleet management companies are at the forefront of this sector in the global marketplace.

While there are many reasons for adoption of IoT, such as cost saving initiatives, process optimisation and operational efficiencies, there are also various challenges posed which could inhibit the growth of IoT. Security is a key concern because if it is breached, it could have major ramifications for both businesses and individuals. Based on the above literature, the researcher has formulated the following hypotheses:

Hypothesis 1a: Characteristics of entrepreneurs for successful IoT ventures are the same as those for unsuccessful IoT ventures.

Hypothesis 1b: Entrepreneur ambitions (desire for success, enthusiasm/capacity for work) is a key determinant for the success of a new IoT venture.

Hypothesis 1c: Education (competence in the field of endeavour, courage, and creativity) is the key hindrance to the success of a new IoT venture.

Hypothesis 2a: The determinants / factors affecting opportunities for IoT entrepreneurs within South Africa are connected car, fleet management, cost saving initiatives and security of data.

2.6 Main problem

Identify the key success factors of South African technology ventures and determine the key sectors offering the greatest opportunity for new technology ventures (NTV) within IoT in South Africa.

2.6.1 Research Question 1

What are the key determinants of successful technology ventures in South Africa?

2.6.2 Hypothesis 1

Hypothesis 1a: Characteristics of entrepreneurs for successful IoT ventures are the same as those for unsuccessful IoT ventures.

Hypothesis1b: Entrepreneur ambitions (desire for success, enthusiasm / capacity for work) is a key determinant for the success of a new IoT venture.

Hypothesis1c: Education (competence in the field of endeavour, courage, and creativity) is the key hindrance to the success of a new IoT venture.

2.6.3 Research Question 2

What are the key factors which will identify IoT entrepreneurship in South Africa?

2.6.4 Hypothesis 2

Hypothesis2a: The determinants / factors affecting opportunities for IoT entrepreneurs within South Africa are connected car, fleet management, cost saving initiatives and security of data.

CHAPTER 3. RESEARCH METHODOLOGY

3.1 Introduction

This chapter will describe the methodology followed to address the hypotheses stated in the previous chapter. It examines in detail the following areas: research methodology, research design, the research population and sample, data analysis and interpretation, research instrument, procedure for data collection, reliability and validity, and limitations of the study.

3.2 Research Methodology / Paradigm

According to Wisker (2012), research methodology forms the basis of a research study by providing the analytical means which includes the collection of data and the methodological process which is used to analyse collections of information and make underlying assumptions. This study is based on a quantitative framework of analysis which depends on methods such as deductive reasoning, analytical research and descriptive survey methods. In order to draw and develop a hypothesis from the actual study, a qualitative approach was used as this was seen as the most suitable methodology.

3.3 Research Design

The research design provides a framework for the data collection and analysis. Subsequently, the selected research design assists in categorising priorities with respect to a range of dimensions of the process of research, such as generalisations and variance between variables (Bryman & Bell 2011). Out of the major research designs available, this study has selected cross- sectional design as, according to Bryman (2011), this research design is the most effective when used to collect data at a single point in time and on more than one case. It is therefore often used to collate quantitative data. This research design is then also used to guide the information gathering process, specifically

relating to the choice of variables and determining the relationship between variables when analysing the data.

3.2.1 Causal Research

Casual research is essential to consider when determining the cause and effect relationship between variables. Bean (2007) argues that in order to determine causality, it is crucial to hold the variable which is anticipated to cause the actual change at a constant and, subsequently, to measure the change in the confounding variables (Bean 2007, p. 23). Ciambella (2008) also argues that it is often difficult to determine the causation of factors that influence variables as this could be dependent on several other variables. In addition, the aforementioned becomes even more complex when dealing with human behaviour as this involves motivation and attitudes, which often forces the researcher to explore deeper psychological considerations that the respondent may sometimes not even be aware of (Ciambella 2008).

3.2.2 Descriptive Research

According to Smith (2008), descriptive research, also known as statistical research, assists in providing research about specific variables, such as population, but it does not provide any formal data on factors of causation. Instead, it provides information about aspects such as the “who, what, when, where and how” of a situation (Smith 2008, p. 241). In addition, Guppy and Gray (2008) argue that descriptive research is used to determine a description that is accurate, systematic and factual, and that this type of research assists in determining aspects such as frequency, including average number of occurrences or central tendencies (Guppy & Gray 2008, p. 87). In contrast, Orcher (2007) states that descriptive research is fallible because it does not provide data about behaviour, motivation or occurrences (Orcher 2007, p. 176). In other words, it cannot establish a causal research relationship between variables.

It is envisaged that the type of design which will provide the most appropriate basis for this study will be correlational research as this will assist in determining the relationships between variables, as well as the degree of the relationship amongst the independent and dependent variables. This will assist the study to identify similarities in the data and, ultimately, prove or disprove the proposed hypotheses

The researcher aims to contact between 300 to 500 individuals in SMEs and Corporate Enterprises that are engaging with South African IoT SME ventures and have experienced both success and failure in working with at least one of these IoT vendors. The reason for selecting individuals in SMEs and Corporates as respondents is that they are the end customers and their perceived success criteria are relevant for new ventures. They would also very likely have had experience with multiple IoT vendors and can probably distinguish between a successful venture and an unsuccessful venture. The proposed study will thus be cross-sectional in design and will use the methodology of Kakati (2003), but will exclude the financial consideration group as this is not relevant for the current study.

3.4 Population and Sample

3.4.1 Population

The population of elements of which certain characteristics are to be investigated is called the target population (Blundell & Stoker 2005) and the population of elements from which the sample is drawn is known as the sampled population. The population of this research will, therefore, constitute individuals in a Corporate Enterprise or in SMEs who have engaged with, or procured services from, a South African IoT SME, as part of the quantitative analysis.

3.4.2 Sample and Sampling Method

The researcher will address a target sample of 500 individuals, aiming to attain at least 200 respondents. The minimum of 200 respondents has been calculated based on a confirmatory factor analysis method which suggests 5 – 10 participants per variable as a guideline (Floyd et al. 1995). The research questionnaire contains 38 variables and six groupings. The study will focus on probability sampling, using a simple random sampling technique.

3.5 The Research Instrument

The quantitative questionnaire was based on existing tools with the actual instrument being an online questionnaire. The online questionnaire will be interactive, but will comprise closed-ended questions. The proposed survey will use a five-point Likert scale rating among other quantitative questioning methods.

3.5.1 Scaled Responses

Scaling, in this context, consists of the theoretical method of enumerating the answers of respondents to multiple choice responses. Barlow (2007) argues that scale responses can be useful in determining codes from scale responses and will thus allow this study to better report with statistical tools using scaled responses whilse generating ordinal and interval data (Barlow 2007, p. 124). Saunders et al. (2003, p.43) endorses the use of questionnaires to identify information for the study and included aspects such as ensuring anonymity and economy of practice with regards to time and money for the respondents.

3.6 Data Analysis and Interpretation

The Statistical package for social scientists, version 22 (SPSS), will be used to analyse the data collected in this research. Data will be analysed and interpreted methodically using descriptive statistics, multiple linear regression and an independent Two-Sample T-Test at 5% level of significance. Multiple Regression Analysis will be used to test how well a set of factors is able to

predict a particular outcome. In particular, multiple regression analysis will be used to test the following hypotheses:

Hypothesis 1b: Entrepreneur ambitions (desire for success, enthusiasm / capacity for work) is a key determinant for the success of a new IoT venture.

Hypothesis 1c: Education (competence in the field of endeavour, courage, and creativity) is the key hindrance to the success of a new IoT venture.

Hypothesis 2a: The determinants / factors affecting opportunities for IoT entrepreneurs within South Africa are connected car, fleet management, cost saving initiatives and security of data.

Percentage frequencies will be used to determine the major groupings among criteria.

The two sample test will be used to test the hypothesis below:

Hypothesis 1a: Characteristics of entrepreneurs for successful IoT ventures are the same as those for unsuccessful IoT ventures.

Descriptive statistics will be used to determine the key factors for identifying IoT entrepreneurship in South Africa.

3.7 Limitations of the Study

This study consisted of several minor limitations which could have been identified, although the most significant limitation of this study was the fact that it was limited to the greater Johannesburg region due to resource constraints. The limitations included financial and non-financial aspects, such as social and work commitments, which meant that this study was restricted to the

Johannesburg region. Given these limitations, the study may not represent a complete view of the problems and questions raised.

3.8 Validity and Reliability

Reliability, in this scenario, refers to the repeatability and consistency of the study (Xaba 2014). The study will use relevant research methodologies and statistical methods, such as Chrobach's Alpha, to increase the reliability of the study. The researcher has also conducted a pilot study to determine the reliability and validity of the questionnaire.

3.8.1 Reliability and Validity of the Questionnaire

In accordance to the abovementioned, Du Plessis (2010) agrees that reliability refers to the consistency of the study when repeated. Babbie and Mouton also (2009) agree with this definition and add that reliability is the art of examining whether a test will produce the same results over a period of time (Babbie & Moutan 2009, p. 125).

To ensure the efficacy and reliability of tested data, the methodological data triangulation method will used on the data collected. As many of the aforementioned authors, Struwig and Stead (2001) agree that reliability refers to the consistency, accuracy and stability of tested research. Thus, to ensure the reliability of this study, it is envisaged that Cronbach's alpha tool will be used as an appropriate tool for interval-level measurement involving multi-term scales.

To examine the homogeneity of internal consistency, the scale reliability of items will be assumed as the fundamental hypothesis of the study. This will ultimately assist in determining whether the items in the questionnaire will be measuring the same variable which would be assumed to be true in a neutral study. With reference to Cronbach's alpha values, they often range between a variance of 0 to 1, with the values providing an indication of the reliability of the study. A score of 1 represents perfect reliability while 0 represents a lack of

reliability. It is, however, common practice to accept a reliability score of 0.6 and above unless explicitly stated in the study. Any value lower than this indicates an unacceptable reliability.

According to Nyadzayo (2010), the alpha coefficient is usually overstated through the inclusion of redundant scale times. This is often true as the alpha coefficient tends to increase with the increase of scale items (Nyadzayo 2010, p. 223). In order to better understand the extent to which the chosen items will manifest the required range of reliability and internal consistency, Cronbach's alpha will be used as follow:

$$\alpha = \frac{K}{K-1}\left(1-\frac{\sum_{i=1}^{K}\sigma^2_{Y_i}}{\sigma^2{}_X}\right)$$

Where:

$$K = \text{number of items}$$
$$\sigma^2{}_X = \text{variance of observed total scores}$$
$$\sigma^2{}_{Y_i} = \text{variance of item i for the current sample}$$

Table 6 illustrates the overall Cronbach alpha value for the study at hand:

	Cronbach's Alpha	Number of items
Questionnaire	0.962	106

Table 6 Cronbach's alpha coefficient for the questionnaire

As discussed above, should the value of Cronbach's alpha be closer to 1, this implies greater reliability. Thus, values between 0.70 – 0.80 are regarded as good reliability and so on. But, should the value lie under 0.60, this warrants questions about the reliability of the data (Hair et al. 2010, p. 708).

Table 6 illustrates that the overall Cronbach alpha value is higher than 0.8.

3.8.2 Validity of Instruments

The validity of measurements often refers to the efficacy of measurements, i.e. the tool that measures the proposed measurement and not anything else. Ritte and Sue (2007) argue that the three most notable types of validity are face validity, content validity and internal validity.

Face Validity

Face validity explores the replication of the content that is assumed to be measured. It is necessary to perform checks under this type of validity to examine both the operational aspects as well as the translation of constructs. This validity thus provides researchers with a way in which to determine the degree to which hypotheses are true and valid with regard to causes. The measures used include the research, the setting and the entire research design (Bean 2007, p.43).

Content Validity

The content validity questions aspects such as the score of the research instrument. It also examines the operationalisation of the items against the relevant content domain for the construct specified in the study. This means that the content validity, which is regarded as non-statistical in nature, can be used to examine the test content to determine whether it covers a representative sample of the behaviour domain to be measured. In order to ensure the content validity of a test, the items included in it have to be carefully selected. These items should be selected in such a way that it forms a sufficient representative sample and complies with the test specification which is devised through a thorough examination of the subject domain to be measured. According to Maxwell (2012), content validity can be greatly improved by measures such as using a panel of experts to review items, and test specifications to ensure that the items cover a representative sample of the behaviour domain (Maxwell, 2012).

Internal Validity

Internal validity is concerned with aspects such as the research design, operational definitions and the use of variables. It is often used to determine whether the research instruments used actually achieved that which they were meant to. In addition, it also identifies the effects caused solely by the independent variable. This study will rely on the use of surveys because, apart from being the most appropriate research tool for this study, surveys also enhance the internal validity of a study.

According to Conrad and Schober (2008), it is common practice to exclude subjects who participated in the pre-test of the final study. The process of construct validation thus includes defining the constructs and hypothesising their relationships to other variables defined (Conrad & Schober 2008, p. 216). Validity is defined as the extent to which a concept is accurately measured in a quantitative study (Heale & Twycross 2015). This study will use a construct validity to show the degree to which measures are theoretically related (convergent validity) or, conversely, whether there is a lack of such a relationship (divergent validity).

3.9 Consistency Matrix

Table 7 below illustrates the consistency matrix.

Identify the key success factors of South African IoT ventures and determine the key sectors offering the greatest opportunity for NTV within IoT in South Africa					
Sub-problem	**Literature review**	**Hypotheses or propositions or research questions**	**Source of data**	**Type of data**	**Analysis**
Identify the key determinants of successful IoT ventures in South Africa	Jesselyn (2003) Kakati (2003) MacMillan et al. (1986) Van Vuuren (2007) Van Vuuren & Groenewald (2007)	**Hypothesis 1a:** Characteristics of entrepreneurs for successful IoT ventures are the same as those for unsuccessful IoT ventures. **Hypothesis 1b:** Entrepreneur ambitions (desire for success, enthusiasm / capacity for work) is a key determinant for the success of a new IoT venture. **Hypothesis 1c:** Education (competence in the field of endeavour, courage, and creativity) is the key hindrance to the success of a new IoT venture.	Quantitative survey – Likert scale Secondary research	Ordinal	Two sample T – test Multiple linear regression analysis Descriptive statistics

Identify the key success factors of South African IoT ventures and determine the key sectors offering the greatest opportunity for NTV within IoT in South Africa					
Sub-problem	**Literature review**	**Hypotheses or propositions or research questions**	**Source of data**	**Type of data**	**Analysis**
Determine the current key vertical sector which poses the highest opportunity for IoT entrepreneurs in South Africa	Haller (2009) Manyika et al. (2015) (Pickett (2014) Simona (2014) Zareen & Tariq (2014)	**Hypothesis 2a:** The determinants / factors affecting opportunities for IoT entrepreneurs within South Africa are connected car, fleet management, cost saving initiatives and security of data.	Quantitative survey – Likert scale Secondary research	Ordinal	Multiple linear regression analysis Descriptive statistics

Table 7: Consistency matrix

3.10 Conclusion

This chapter examined the research methodology, research design, population and sample, the research instrument, data analysis techniques, research limitations, the consistency matrix, and the validity and reliability. In the following chapter, the research results will be presented. The chapter concentrates on the responses of the respondents to the questions in the questionnaires. Hypotheses tests, tables and charts will be used to aid the analysis of the data.

CHAPTER 4: PRESENTATION OF RESULTS

4.1 Introduction

The purpose of this chapter is to present the results obtained from the empirical findings. The data from the questionnaires was analysed using SPSS version 22.0. Data was collected from a total sample size of 215 respondents across enterprises in South Africa. The reliability of the data collection instrument was tested by using the Cronbach alpha coefficient. The presentation used mainly descriptive statistics, such as charts and frequency tables. Inferential statistics was also used to carry out hypotheses testing.

4.2 Demographic Profile of Respondents

The planned target sample was 200 and the actual sample was 215, which exceeded the planned target by 15 respondents. Figures 6 to 10 show the positions of respondents in their organisations, the involvement of the respondents in IT and Communications Strategy decisions for their organisations, the number of permanent employees in their organisations, the industry sector of the organisations and a description of how decisions are taken in their organisations. As highlighted earlier, IoT traverses industries and business units and, as such, the researcher aimed to obtain respondents across the key industries in South Africa, as well as across various designations from decision-makers to actual users of IoT.

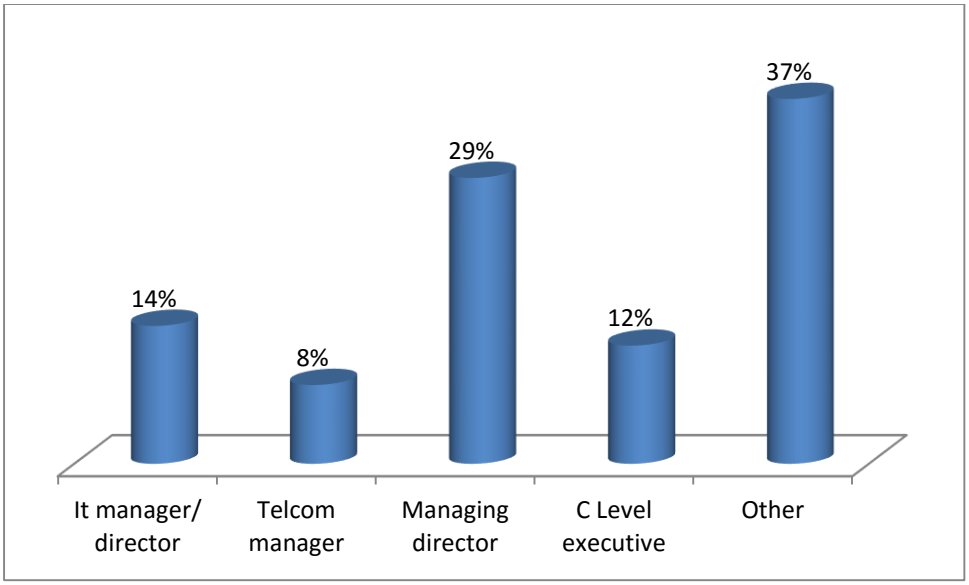

Figure 6: What is your current position in your organisation?

Quite a significant percentage of the respondents are managing directors (29%), followed by IT managers or directors and c-level executives.

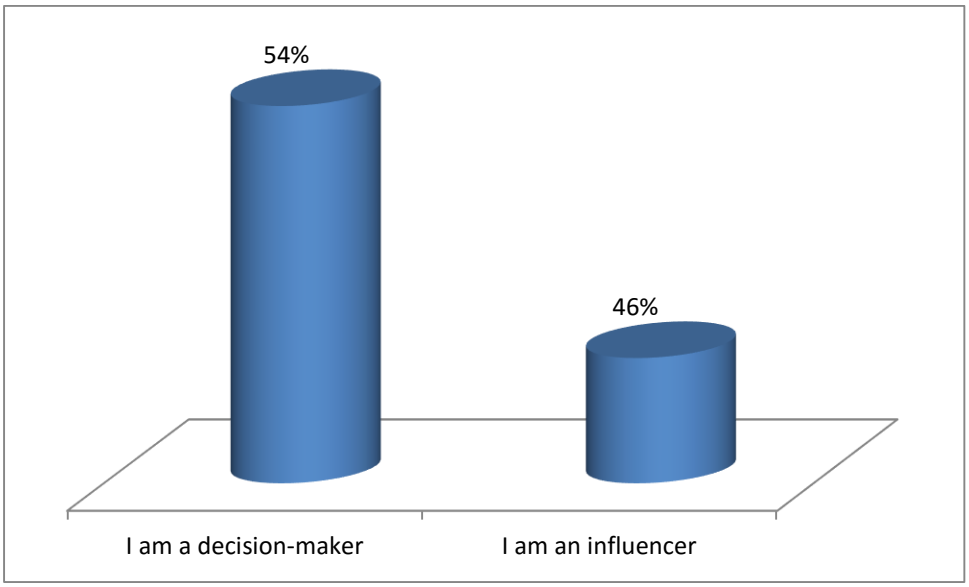

Figure 7: Could you please tell me what best describes your involvement in IT and Communications Strategy decisions for your organisation?

More decision-makers participated in the research than influencers, as is indicated in Figure 7 above.

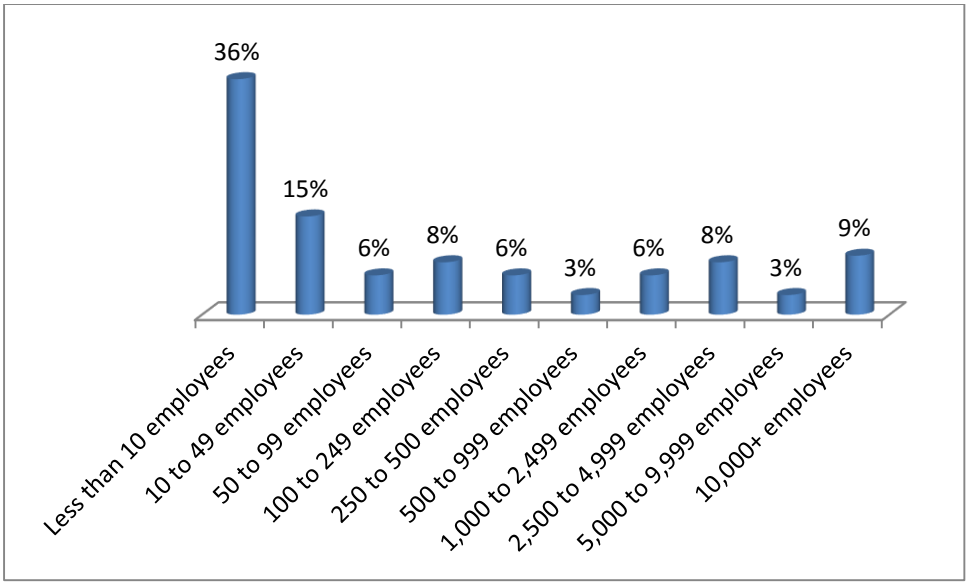

Figure 8: Could you please tell me how many permanent employees there are in your organisation in South Africa?

The majority of the respondents had less than 10 employees in their companies (36%), while 15% have between 10 and 49 employees inclusive and 26% have more than 1000 employees.

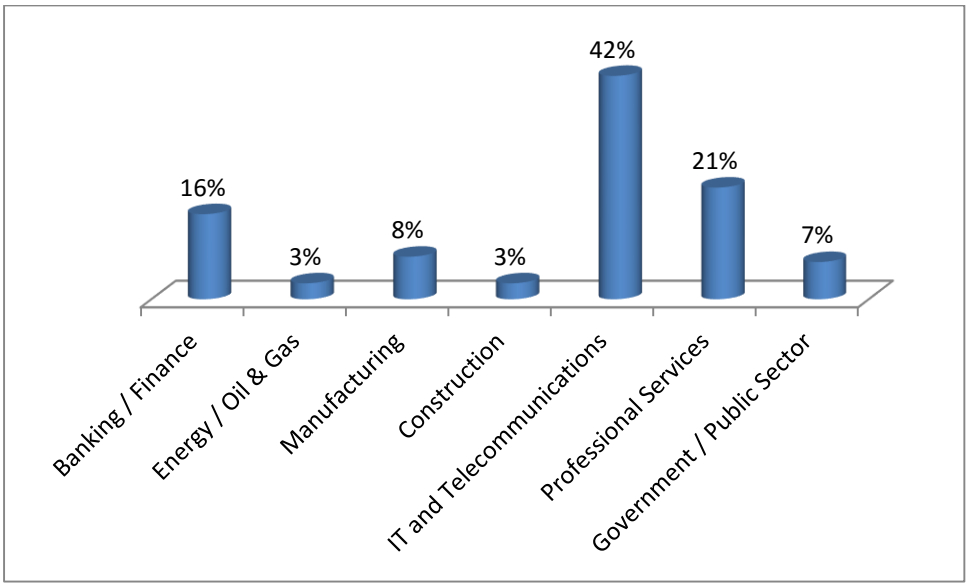

Figure 9: Could you please tell me in which industry sector your organisation operates?

Figure 9 above shows that the majority of the companies that participated in the research are in the IT and Telecommunications (42%) sector, followed by professional services (21%) and banking or finance (16%) in that order.

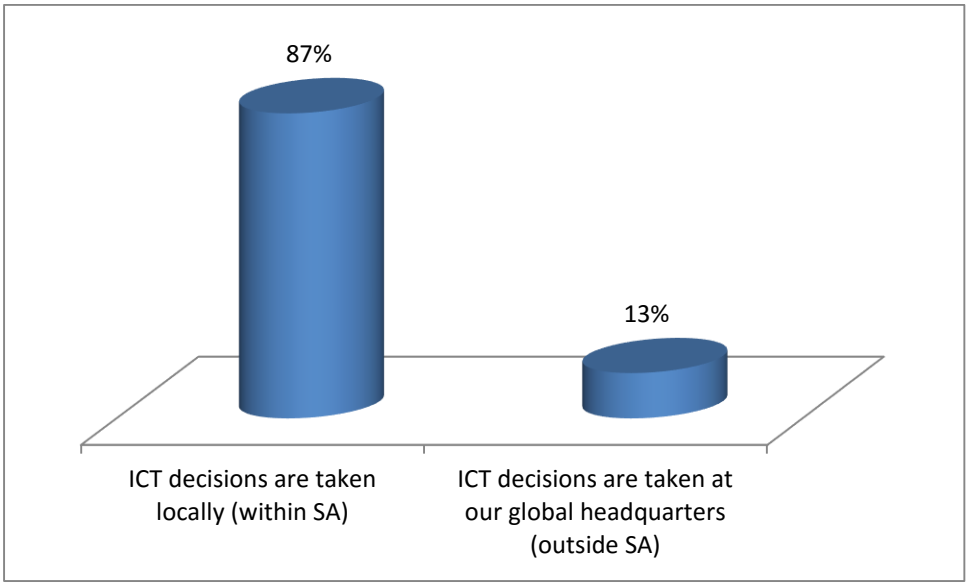

Figure 10: Could you please tell me which of the following statements represents how ICT decisions are taken in your organisation?

It is quite evident from Figure 10 that most of the ICT decisions are taken locally (in South Africa) rather than at the global headquarters.

The results reveal that there is a vibrant SMME market in South Africa with nearly 50% of the respondents having under 50 employees. Even more rewarding for entrepreneurship in South Africa was the staggering 87% of respondents confirming that their ICT decisions are taken locally which could lead to possible opportunities for IoT entrepreneurs in South Africa.

4.3 Reliability and Validity of the Study

	Cronbach's alpha	Number of items
Questionnaire	0.962	106

Table 8: Cronbach's alpha coefficient for the questionnaire

The overall Cronbach Alpha coefficient of reliability for the questionnaire is 0.962. This means that the questionnaire is consistent and measures what it was supposed to measure adequately. This questionnaire will yield the same results in different occasions and will produce similar observations when administered on different assertions. The data collection instrument is 96% accurate and there is only a 4% measurement error on the items. The data collection instrument has a very high internal consistency. According to DeVillis (2003), the Cronbach alpha coefficient of a questionnaire should be at least 0.70 for the questionnaire to be considered reliable. Since reliability of the data collection instrument is a prerequisite for validity, it can also be said that the research was valid.

4.4 Key Factors for Identifying IoT Entrepreneurship in South Africa

4.4.1Successful Entrepreneurs

The following characteristics of entrepreneurs are key to their success:

- Competence in field of endeavour – 97%
- Ability to evaluate and react well to risk – 97%
- Capability for sustained intense effort – 96%
- Creativity – 96%
- Enthusiasm / capacity of work – 96%
- Attention to detail - 95%
- Familiarity with the target market – 95%

Characteristics	Highly unimportant	Marginally unimportant	Neither important nor unimportant	Marginally important	Highly important
Size of venture team	4%	44%	20%	19%	13%
Desire for success	2%	1%	1%	11%	85%
Creativity	1%	1%	2%	46%	50%
Courage	1%	3%	5%	18%	73%
Enthusiasm / capacity of work	1%	1%	2%	13%	83%
Competence in field of endeavour	1%		2%	56%	41%
Capability for sustained intense effort	1%	1%	2%	55%	41%
Ability to evaluate and react well to risk	1%		2%	18%	79%
Ability to articulate in the discussion	1%	3%	5%	20%	73%
Attention to detail	1%	2%	1%	21%	74%
Familiarity with the target market	1%	1%	3%	49%	46%
Leadership quality	1%	1%	4%	28%	66%
Track record that was relevant to venture	1%	7%	17%	25%	50%

Table 9: Characteristics of entrepreneurs

With IoT being an emerging technology in its early stage along the product lifecycle, the results clearly show that experience and competence is a key characteristic to success. At the same time, the respondents acknowledge that as IoT is still new, there will be challenges and risks as are associated with all new or emerging technologies. Hence, another key characteristic identified is the ability to evaluate and react well to the risk.

Capability	Highly unimportant	Marginally unimportant	Neither important nor unimportant	Marginally important	Highly important
Managerial	1%	1%	7%	29%	63%
Technical	1%		4%	53%	43%
Marketing	1%	2%	34%	25%	39%
Input sourcing	1%	1%	33%	42%	23%

Table 10: Resource-based capability

According to the research results the most important resource-based capabilities are technical (96%) and managerial (92%). This finding is aligned with emerging technology where marketing and input sourcing is not as vital as the technical build-up of the solution and the management team driving the entity.

Strategy	Highly unimportant	Marginally unimportant	Neither important nor unimportant	Marginally important	Highly important
Quality strategy	1%	1%	2%	53%	44%
Cost strategy	1%	2%	33%	19%	46%
Innovation strategy	1%	1%	4%	40%	54%
Customisation strategy	1%	3%	34%	23%	40%

Table 11: Competitive strategy

The main competitive strategies identified for IoT in this research are quality strategy (97%) and innovation strategy (94%). The results show that cost is not as yet a key factor, but that innovativeness and quality of the offering will be key to success.

Product characteristics	Highly unimportant	Marginally unimportant	Neither important nor unimportant	Marginally important	Highly important
Uniqueness of product / services relative to competitors	1%		11%	25%	63%
Protection of the product	1%	3%	11%	27%	59%
Product enjoyed market acceptance	1%	1%	6%	44%	49%
Product developed to functioning prototype	1%	1%	5%	55%	38%
Product was in early stage of development	2%	8%	40%	35%	14%

Table 12: Product characteristics

The most important product characteristics are product enjoyed market acceptance (93%) and product developed to functioning prototype (93%).

Market characteristics	Highly unimportant	Marginally unimportant	Neither important nor unimportant	Marginally important	Highly important
An untapped market potential		4%	8%	57%	31%
Access to well-established distribution channel	1%	1%	34%	26%	39%
Market enjoying significant growth rate	1%	2%	34%	31%	33%
Venture stimulates existing market	1%	2%	36%	32%	29%
Familiarity with industry structure	1%	1%	7%	56%	35%
Venture created a new market / segment	1%	27%	17%	24%	31%

Table 13: Market characteristics

The most important market characteristics for successful entrepreneurs are familiarity with industry structure (91%) and an untapped market potential (88%). The results overall for a successful IoT entrepreneur is aligned to an emerging technology where the actual product, its market acceptance, technical capability, quality, etc. are more important than cost and marketing, etc.

4.4.2 Unsuccessful Entrepreneurs

Tables 14 to 18 describe the different characteristics of unsuccessful entrepreneurs.

Characteristics	Highly unimportant	Marginally unimportant	Neither important nor unimportant	Marginally important	Highly important
Size of venture team	9%	36%	21%	10%	25%
Desire for success	37%	7%	14%	15%	27%
Creativity	38%	10%	9%	16%	27%
Courage	39%	10%	11%	14%	27%
Enthusiasm / capacity for work	40%	5%	12%	16%	27%
Competence in field of endeavour	36%	7%	10%	22%	24%
Capability for sustained intense effort	37%	10%	13%	21%	19%
Ability to evaluate and react well to risk	40%	9%	13%	13%	26%
Ability to articulate in the discussion	36%	5%	14%	21%	24%
Attention to detail	37%	6%	11%	19%	27%
Familiarity with the target market	35%	9%	19%	11%	27%
Leadership quality	37%	7%	14%	12%	30%
Track record that was relevant to venture	35%	9%	17%	16%	22%

Table 14: Characteristics of entrepreneurs

It is evident from the above table that characteristics vary among unsuccessful entrepreneurs, although findings related to lack of courage and the inability to react well to risk were the key characteristics of unsuccessful IoT entrepreneurs.

Capability	Highly unimportant	Marginally unimportant	Neither important nor unimportant	Marginally important	Highly important
Managerial	37%	9%	13%	16%	25%
Technical	13%	7%	38%	17%	25%
Marketing	13%	10%	40%	18%	20%
Input sourcing	36%	6%	21%	14%	22%

Table 15: Resource-based capability

Respondents highlighted lack of managerial capability (46%) as being the key characteristic of an unsuccessful venture.

Strategy	Highly unimportant	Marginally unimportant	Neither important nor unimportant	Marginally important	Highly important
Quality strategy	14%	32%	13%	16%	25%
Cost strategy	14%	5%	14%	38%	30%
Innovation strategy	16%	29%	15%	12%	28%
Customisation strategy	13%	32%	20%	12%	24%

Table 16: Competitive strategy

Unsuccessful entrepreneurs exhibit low quality strategy (46%), innovation strategy (45%) and customisation strategy (45%), all of which are found to be important for successful IoT entrepreneurs

Product characteristics	Highly unimportant	Marginally unimportant	Neither important nor unimportant	Marginally important	Highly important
Uniqueness of product / services relative to competitors	37%	11%	14%	15%	23%
Protection of the product	34%	7%	18%	15%	26%
Product enjoyed market acceptance	34%	11%	19%	14%	22%
Product developed to functioning prototype	38%	7%	21%	16%	19%
Product was in early stage of development	34%	11%	21%	14%	20%

Table 17: Product characteristics

Quite a significant percentage of the respondents thought that all the product characteristics given in the above table are unimportant for unsuccessful entrepreneurs.

Market characteristics	Highly unimportant	Marginally unimportant	Neither important nor unimportant	Marginally important	Highly important
An untapped market potential	36%	12%	12%	15%	24%
Access to well-established distribution channel	34%	12%	15%	18%	21%
Market enjoying significant growth rate	10%	9%	43%	17%	20%
Venture stimulates existing market	13%	31%	21%	17%	20%
Familiarity with industry structure	10%	35%	17%	18%	19%
Venture created a new market / segment	13%	34%	20%	16%	18%

Table 18: Market characteristics

Most of the respondents indicated that unsuccessful entrepreneurs do not have any regard for market characteristics that are highly valued by successful entrepreneurs.

Hypotheses 1

Hypothesis 1a: Characteristics of entrepreneurs for successful IoT ventures are the same as those for unsuccessful IoT ventures.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Q9.14	4.32	215	.615	.042
	Q15.14	2.67	215	1.485	.101

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Q9.14 - Q15.14	1.656	1.489	.102	1.456	1.856	16.304	214	0.000

Conclusion: Since the p-value = 0.000 < 0.05, H1a is rejected and it is concluded that the characteristics for entrepreneurs of successful technology ventures are notthe same as those for unsuccessful technology ventures.

Hypothesis 1b: Entrepreneur ambitions (desire for success, enthusiasm / capacity for work) is a key determinant for the success of a new IoT venture.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	26.755	2	13.378	52.422	0.000[b]
	Residual	54.100	212	.255		
	Total	80.856	214			

a. Dependent variable: Q9.14

b. Predictors (constant): Q9.5, Q9.2

Coefficients[a]

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.468	.282		5.202	0.000
	Q9.2	0.264	.061	.285	4.317	0.000
	Q9.5	0.336	.060	.371	5.620	0.000

a. Dependent variable: Q9.14 = Average of all the successful entrepreneur characteristics

b. Q9.14

c. Q9.3 = Desire for success

d. Q9.5 = Enthusiasm / capacity for work

Conclusion: Since the p-value = 0.000 < 0.05 for the regression equation, it means that the model is significant. On the coefficients table, the two p-values for desire for success and enthusiasm or capacity for work are significant (p-value = 0.000). It can also be concluded that the determinant, enthusiasm, is more important than desire for success.

Hypothesis 1c: Education (competence in the field of endeavour, courage, and creativity) is the key hindrance to the success of a new IoT venture.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	437.818	3	145.939	903.802	0.000[b]
	Residual	34.071	211	.161		
	Total	471.888	214			

a. Dependent variable: Q15.14

b. Predictors (constant): Q15.6, Q15.4, Q15.3

Coefficients[a]

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.118	.056		2.093	0.038
	Q15.3	0.279	.053	.317	5.299	0.000
	Q15.4	0.228	.050	.259	4.526	0.000
	Q15.6	0.384	.035	.426	11.102	0.000

a. Dependent variable: Q15.14 = Average of all the unsuccessful entrepreneur characteristics

b. Q15.3 = Creativity

c. Q15.4 = Courage

d. Q15.6 = Competence in field of endeavour

Conclusion: Since the p-value = 0.000 < 0.05 for the regression equation, it means that the model is significant. On the coefficients table, the three p-values for creativity, courage and competence in the field of endeavour are significant (p-value = 0.000). It can also be concluded that the determinant, competence, in the field of endeavour is the main hindrance, followed by creativity and then courage in that order.

4.5 Determining the Key Factors for IoT Entrepreneurship in South Africa

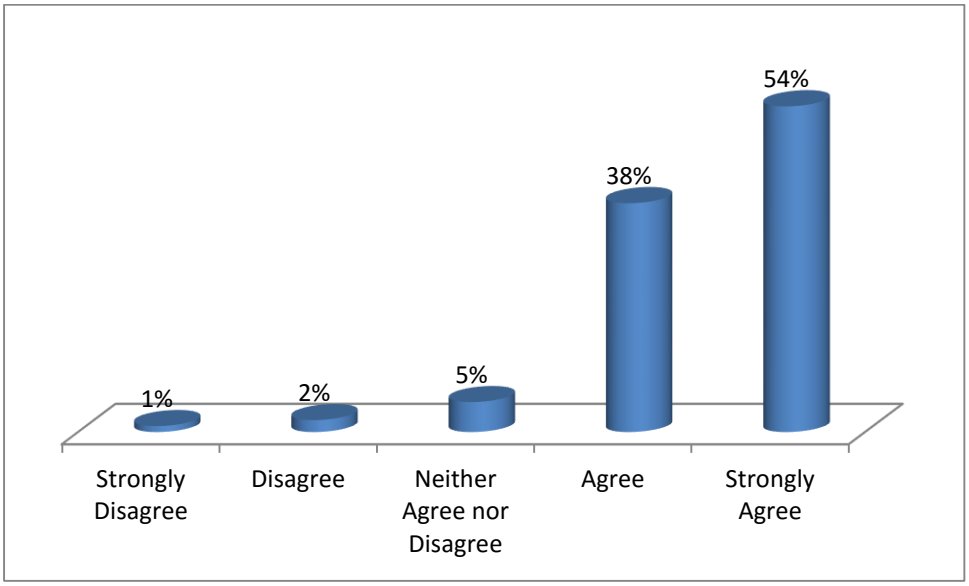

Figure 11: Business priority – Innovation

About 92% of the respondents said that innovation is a top business priority for their organisations.

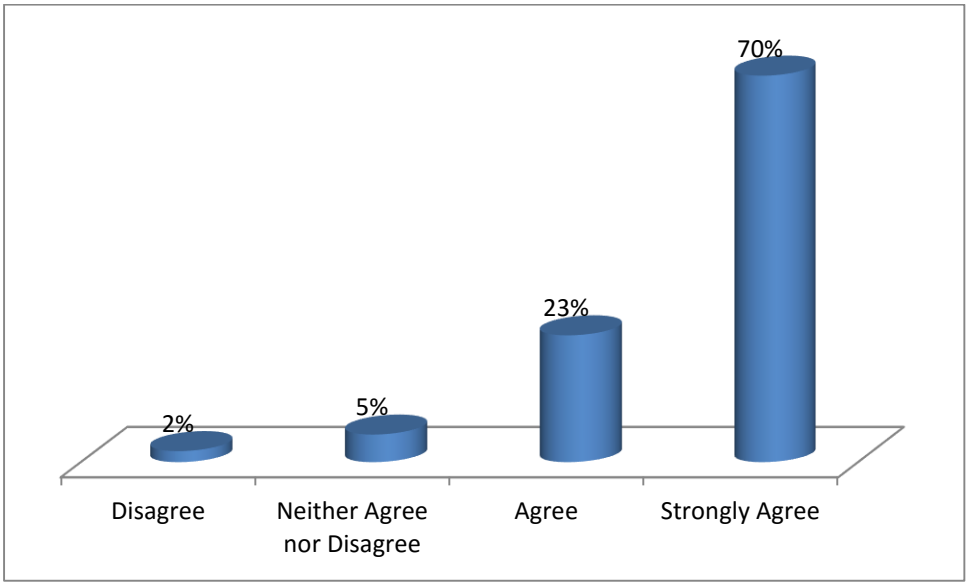

Figure 12: Business priority - Cost saving

Quite a significant percentage of the respondents (93%) said that cost saving is a top business priority for their organisations.

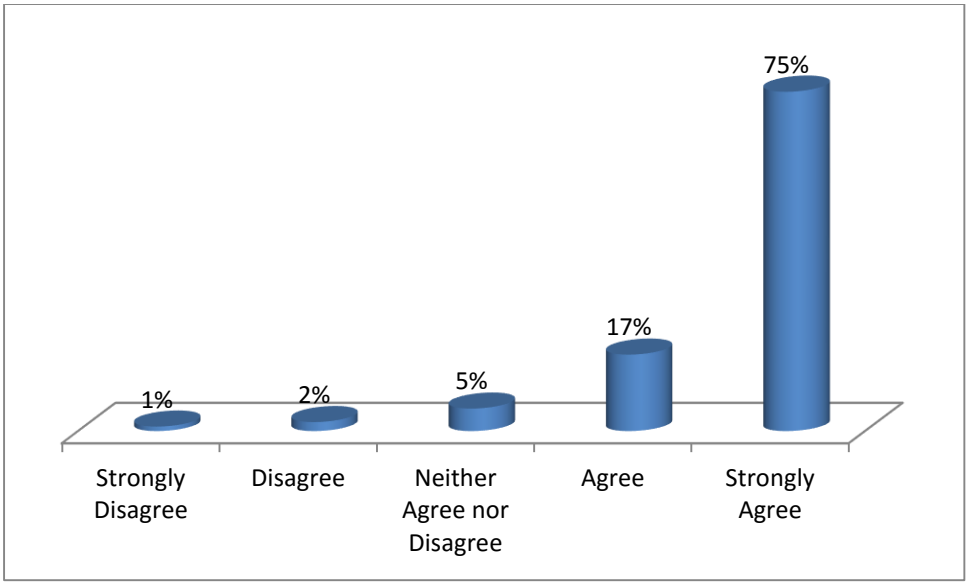

Figure 13: Business priority - Creating new revenue streams

Most respondents (92%) said that creating revenue streams is a business priority.

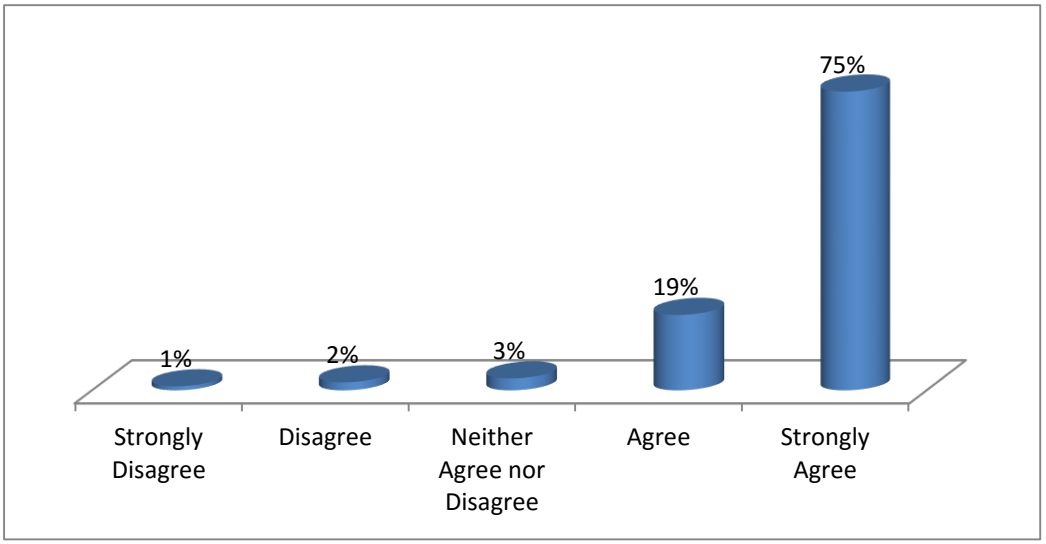

Figure 14: Business priority – Profitability

Figure 14 shows that most businesses prioritise profitability (94%) ahead of all the other aspects of business.

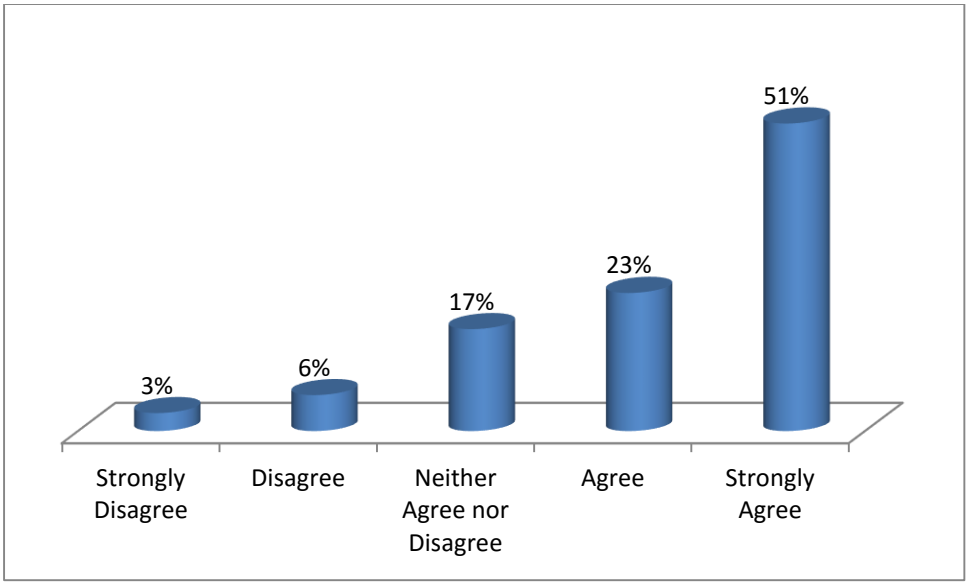

Figure 15: Business priority – Going green

Going green is the least important aspect of businesses in South Africa as shown in Figure 15.

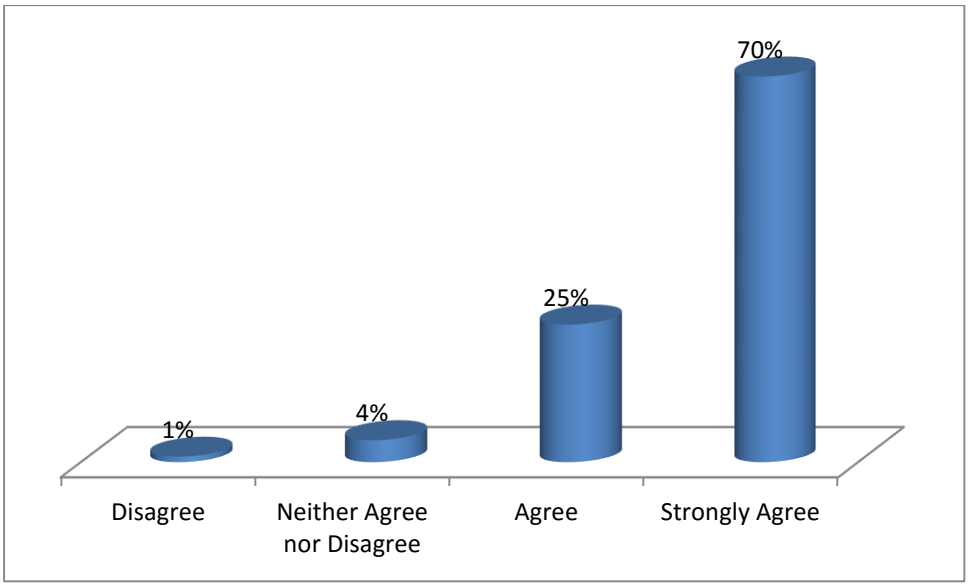

Figure 16: Addressing in-house priorities

Most of the respondents (95%) agreed that in-house priorities should be addressed.

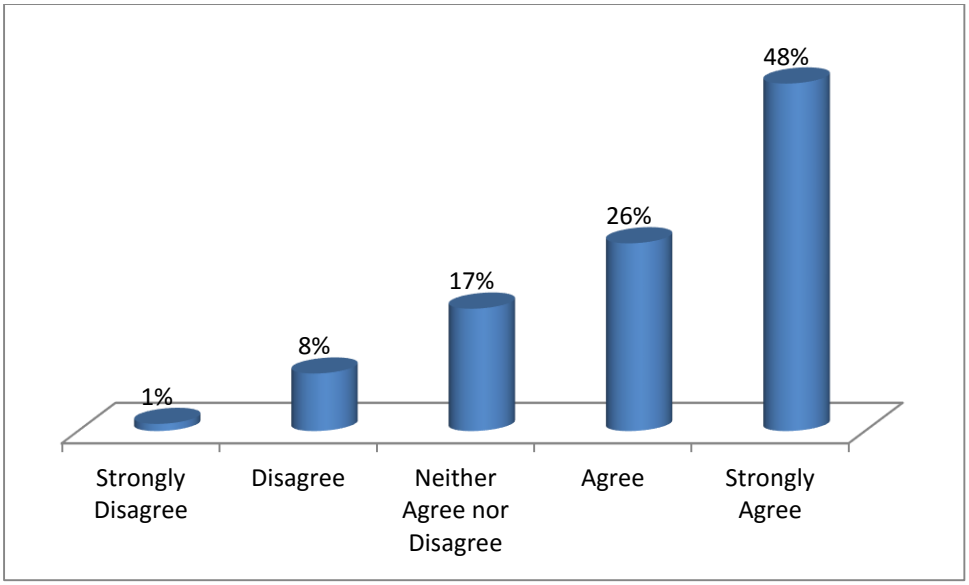

Figure 17: Addressing external priorities

Figure 17 above shows that addressing in-house priorities (95%) is more important than addressing external priorities (74%).

IoT Service	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Fleet management	24%	14%	15%	18%	29%
Digital signage	22%	11%	13%	20%	34%
POS terminals and ticketing	25%	15%	16%	11%	34%
Connected cabinets and vending machines	27%	16%	15%	10%	32%
Energy data management	21%	7%	13%	21%	39%
Asset tracking	19%	4%	11%	24%	42%
Connected cars	22%	13%	17%	16%	32%
Usage-based insurance	21%	5%	17%	23%	34%
Remote diagnostics and maintenance	2%	5%	10%	40%	43%
Smart home solutions	23%	9%	11%	19%	39%

Table 19: Which IoT services would be most beneficial to your organisation?

Table 19 above shows that the most beneficial IoT services to organisations are:

- Remote diagnostics and maintenance (83%)
- Asset tracking (66%)
- Energy data management (60%)
- Smart home solutions (59%)
- Connected cars (58%)
- Usage-based insurance (57%)

Sector	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Human	1%	2%	6%	28%	63%
Home	1%	5%	7%	24%	63%
Retail environment	1%	1%	7%	27%	64%
Offices	1%	1%	7%	29%	62%
Factories	1%	2%	8%	26%	63%
Vehicles		2%	10%	27%	61%
Cities		1%	8%	22%	69%
Environment		4%	13%	21%	63%

Table 20: In which sector do you perceive IoT having the largest impact in South Africa?

The majority of the respondents thought that IoT in South Africa has the largest impact in the following sectors:

- Human (91%)
- Retail environment (91%)
- Offices (91%)
- Cities (91%)
- Factories (89%)
- Vehicles (88%)
- Homes (87%)

Key challenges	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Security of personal data	1%	1%	5%	43%	50%
Connectivity		1%	5%	23%	71%
Lack of clear role	1%	5%	13%	41%	40%
Device or module challenges		6%	14%	43%	37%
Pricing		3%	8%	28%	61%
Quality of service	1%	4%	8%	24%	63%

Table 21: What are the key challenges experienced / perceived in the use of IoT solutions?

The main perceived challenges for the use of IoT solutions are:

- Connectivity (94%)
- Security of personal data (93%)
- Pricing (89%)
- Quality of service (87%)

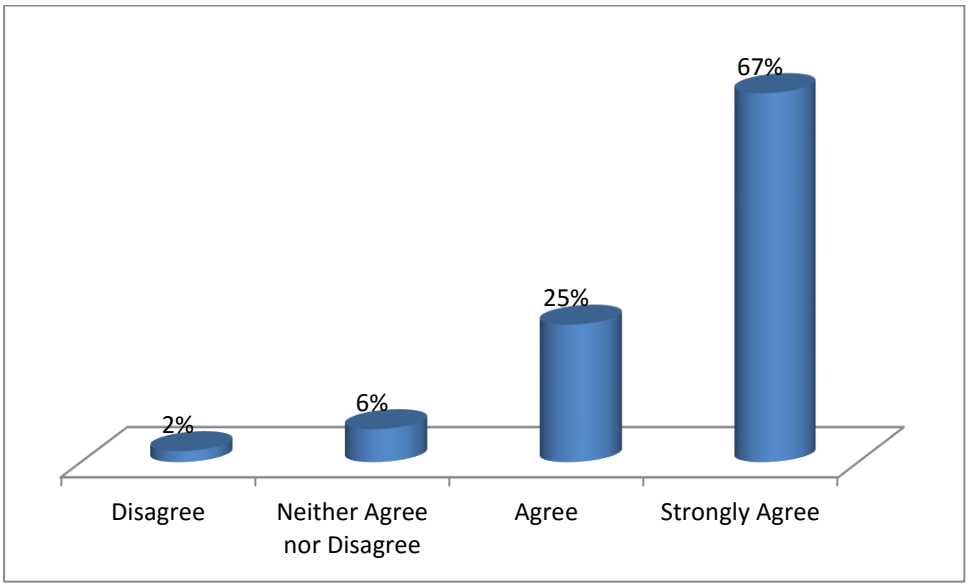

Figure 18: Indicate the largest impact of IoT technologies on your company's performance - Operational performance

Quite a significant percentage of the respondents (92%) agreed that IoT technologies have the largest impact on their companies' operational performance.

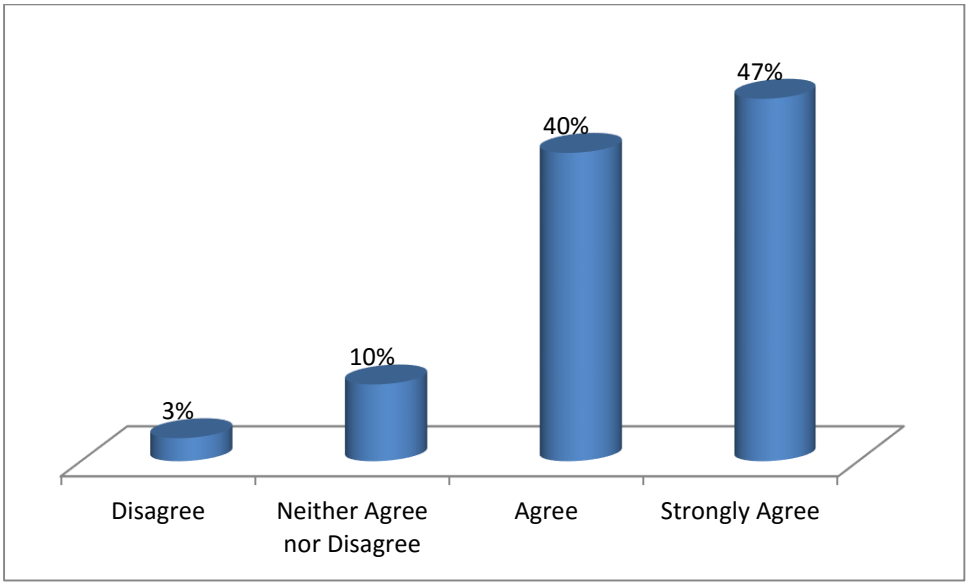

Figure 19: Indicate the largest impact of IoT technologies on your company's performance - Financial performance

Figure 19 above shows that IoT has the largest impact on the financial performance of companies (87%).

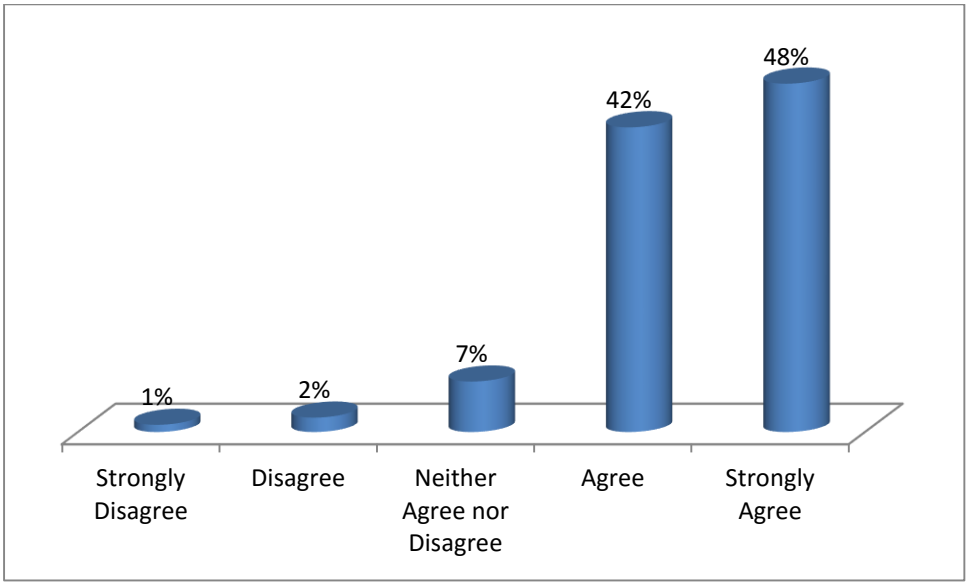

Figure 20: Indicate the largest impact of IoT technologies on your company's performance - Innovation

Of the respondents, 90% agreed that IoT technologies have the largest impact on the innovation performance of their companies.

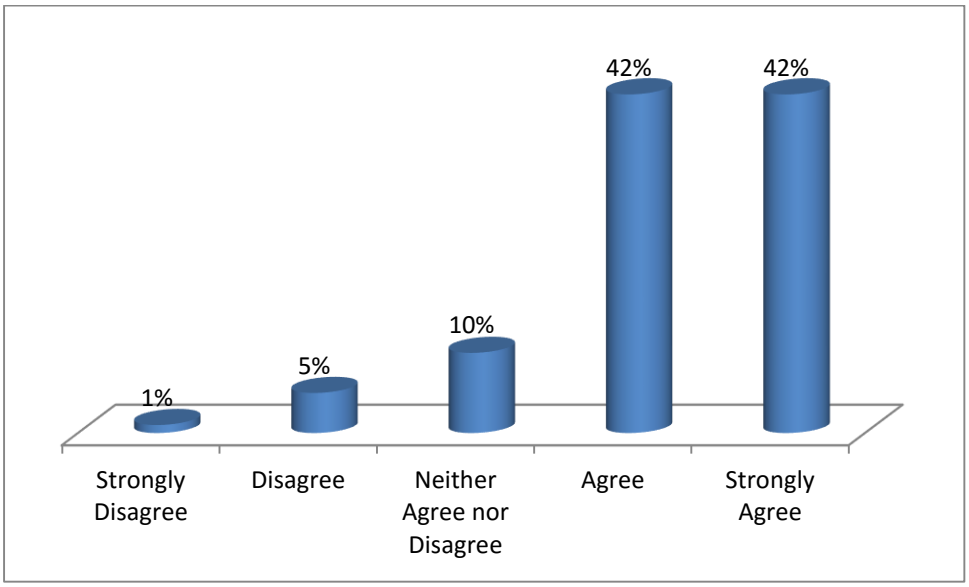

Figure 21: Indicate the largest impact of IoT technologies on your company's performance - Security

Figure 21 shows that IoT technologies have the largest impact on the security performance of their companies.

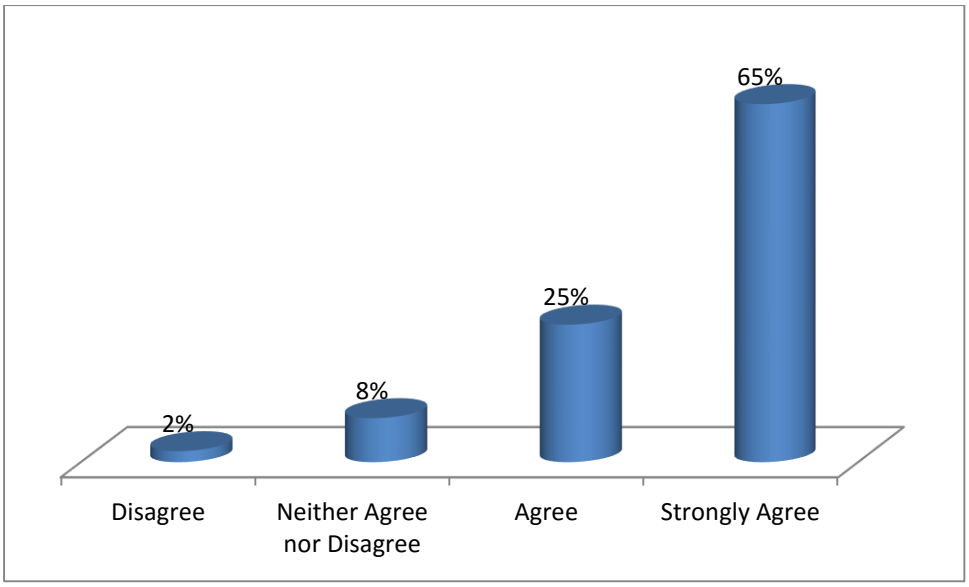

Figure 22: An IoT entrepreneurial venture has many opportunities in South Africa

The majority of the respondents (90%) agreed that an IoT entrepreneurial venture has many opportunities in South Africa.

Hypothesis 2

Hypothesis 2a: The determinants / factors affecting opportunities for IoT entrepreneurs within South Africa are connected car, fleet management, cost saving initiatives and security of data.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	360.584	4	90.146	321.889	0.000[b]
	Residual	58.811	210	.280		
	Total	419.395	214			

a. Dependent variable: Q23.12

b. Predictors (constant): Q25.1, Q21.1, Q23.1, Q23.7

Coefficients[a]

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-0.368	.319		-1.153	0.250
	Q21.1	0.060	.057	.032	1.052	0.294
	Q23.1	0.397	.045	.443	8.764	0.000
	Q23.7	0.412	.049	.457	8.454	0.000
	Q25.1	0.210	.056	.105	3.738	0.000

a. Dependent variable: Q23.12 = Average of all the benefits of IoT to organisations

b. Q21.1 = Cost saving initiatives

c. Q23.1 = Fleet management

d. Q23.7 = Connected cars

e. Q25.1 = Security of personal data

Conclusion: Since the p-value = 0.000 < 0.05 for the regression equation, it means that the model is significant. On the coefficients table, the three p-values for fleet management, connected cars and security of personal data are

significant (p-value = 0.000) and cost saving initiatives is not significant (p-value = 0.294 > 0.05). It can also be concluded that the most important determinants are connected cars, followed by fleet management and security of personal data in that order.

4.5 Summary of the Results

Table 22 below illustrates a summary of the hypotheses that were tested and whether each of the hypotheses was supported by the data. Of the four research hypotheses, two were fully supported and one was partially supported, while one hypothesis was not supported by the data collected.

Research hypothesis	Results	Factors
Hypothesis 1a: Characteristics of entrepreneurs for successful IoT ventures are the same as those for unsuccessful IoT ventures.	**Not supported**	All factors rejected
Hypothesis 1b: Entrepreneur ambitions (desire for success, enthusiasm / capacity for work) is a key determinant for the success of a new IoT venture.	**Supported**	All factors accepted
Hypothesis 1c: Education (competence in the field of endeavour, courage, and creativity) is the key hindrance to the success of a new IoT venture.	**Supported**	All factors accepted
Hypothesis 2a: The determinants / factors affecting opportunities for IoT entrepreneurs within South Africa are connected car, fleet management, cost saving initiatives and security of data.	**Partially supported**	All factors except for cost savings are accepted

Table 22: Summary of research hypotheses

4.5.1 The Key Determinants of Successful Technology Ventures in South Africa

The main characteristics of successful entrepreneurs are competence in field of endeavour, ability to evaluate and react well to risk, capability for sustained intense effort, creativity, enthusiasm / capacity for work, attention to detail, familiarity with the target market, ability to articulate in the discussion, leadership quality and courage. According to the research results, the most important resource-based capabilities are technical and managerial. The main competitive strategies identified for IoT in this research are quality strategy and innovation strategy. The characteristics of successful entrepreneurs are the opposite of those for unsuccessful entrepreneurs. The most important product characteristics are product enjoyed market acceptance, product developed to functioning prototype, uniqueness of product / services relative to competitors and protection of the product. The most important market characteristics for successful entrepreneurs are familiarity with industry structure and an untapped market potential.

It was also established that entrepreneur ambitions (desire for success, enthusiasm / capacity for work) is a key determinant for the success of a new IoT venture and that education (competence in field of endeavour, courage, and creativity) is the key hindrance to the success of a new IoT venture.

4.5.2 The key factors for identifying IoT entrepreneurship in South Africa

The key factors for identifying IoT entrepreneurship in South Africa are innovation, cost saving, creating new revenue streams, profitability and going green. The most beneficial IoT services to organisations are remote diagnostics and maintenance, asset tracking, energy data management, smart home solutions, connected cars and usage-based insurance. The majority of the respondents thought that IoT in South Africa has the largest impact in the following sectors: human, retail environment, offices, cities, factories and vehicles. The main perceived challenges for the use of IoT solutions are connectivity, security of personal data, pricing and quality of service. It was

also established from the data that the determinants / factors affecting opportunities for IoT entrepreneurs in South Africa are connected car, fleet management and security of data.

CHAPTER 5. DISCUSSION OF THE RESULTS

5.1 Introduction

This chapter presents a discussion on the findings from the literature review and the quantitative study. The discussion is aimed at validateing the model for determining the key success factors for establishing and sustaining an Internet of Things (IoT) new technology venture (NTV) in South Africa. The chapter is structured as follows: first there is a discussion on the demographics of the respondent profile; this is followed by a discussion on factors that determine IoT entrepreneurship in South Africa; this then sets the stage for a detailed discussion of all the hypotheses, whether supported, partially supported or not supported by the data and reasons for this; finally, a summary of the chapter is provided.

5.2 Demographic Profile of Respondents

The research findings discussed in this section are based on the survey data collected from 215 respondents who provided feedback on IoT success for new venture technology enterprises. The aim of the demographics component was to assess whether the profile of respondents was suitable.

The criteria for respondents were that they needed to be from a South African registered IoT new venture or involved in IoT decision making in a South African enterprise. Respondents may have been a customer of another IoT venture and responsible for procurement or project engagement with South African technology ventures. The respondents may also have rendered services or solutions by an SME IoT venture. As stated in the literature review, the reason for selecting individuals in SMEs and Corporates as respondents is that they are the end customers and their perceived success criteria are relevant for a new venture. They also would have had experience with multiple IoT vendors

and can therefore probably distinguish between a successful venture and an unsuccessful venture.

In addition, the study's main problem was to identify the key success factors (characteristics of entrepreneurs, entrepreneur ambitions and education) of South African technology ventures and IoT entrepreneurship, and to determine which key sectors offer the greatest opportunity for NTV in IoT in South Africa. As highlighted in the literature review, IoT traverses industries and business units and the study was therefore aimed at obtaining respondents across the key industries in South Africa, as well as across various designations, from decision-makers to actual users of IoT. The demographic analysis indicates the positions of respondents in their organisations, the involvement of the respondents in IT and Communications Strategy decisions for their organisations, the number of permanent employees in their organisations, the industry sector of the organisations, and a description of how decisions are taken in their organisations.

In line with the above, the data showed that the majority of respondents are from the SME segment, with 51% of the respondents from companies with less than 50 employees. This meets the South African definition of SME enterprises which should have 200 employees or less (DTI 2016). The respondents were largely managing directors which constituted 29% of the population sample. Managing directors in small start-ups or SMEs are generally more entrepreneurial or are, in fact, entrepreneurs in the enterprise and are the key decision-makers. This is supported by 54% of the respondents mentioning that they are the decision-makers in the company. This will have a significant influence on purchasing or procurement decisions of IoT in the enterprise in particular and is further supported by the fact that 87% of the decisions are taken locally which could lead to an increase of opportunities or IoT adoption for IoT entrepreneurs. In addition, the fact that the respondents are from the IT and Telecommunications sectors, shows that the respondents may be knowledgeable about IoT and could give appropriate feedback necessary for

the study. Of the respondents, 42% were from the IT and telecommunications industry.

Aligning the above, the criteria was met, from a demographic perspective, to ensure that feedback attained from the respondents was relevant and factual to the study.

5.3 Descriptive Statistics Discussion

This section provides a descriptive statistics discussion for determining the key factors for identifying IoT entrepreneurship in South Africa. This aims to set the stage for the research hypotheses discussion in the next section. The quantitative study suggests that a high percentage of the respondents felt that IoT would be beneficial for their business priorities which include being innovative, ensuring cost savings, being able to create new revenue streams, ensuring profitability, and easily providing a way to ‘go green’. Respondents also believed that IoT would provide them with the means to address their in-house priorities more efficiently and effectively.

In line with the literature review, respondents felt that the most beneficial IoT services for organisations are remote diagnostics and maintenance, asset tracking, energy data management, smart home solutions, connected cars and usage-based insurance. Respondents felt that IoT has the largest impact on the human, retail environment, offices, cities, factories, vehicles and homes sectors. This is in line with the Mckinsey analysis which is a bottom-up approach for identifying the sectors which will provide the greatest impact for the Internet of Things.

Findings also show that for those respondents making use of IoT in their organisations, the largest impact of IoT on their companies’ performance were operational performance and financial performance which, in turn, allow them to be more innovative and security performance. However, in terms of the

hypotheses discussion, the findings from the total population sample will show that this was not the case for financial performance and security performance.

5.4 Research Hypotheses Discussion

This section provides a summary of the hypotheses proposed in Chapter 2 and the results from the tests performed to determine whether the hypotheses were supported by the data in Chapter 4. As Table 22 in Chapter 4 illustrates, out of the four research hypotheses, two were fully supported, one was partially supported, and one hypothesis was not supported by the data collected. For the fully supported hypotheses, tests showed that the factors of desire for success and enthusiasm / capacity for work that make up entrepreneur= ambitions were significant key determinants for the success of a new IoT venture. In addition, factors of competence in the field of endeavour, courage and creativity, which all fall under education, were significant hindrances to the success of a new venture. These make up Hypothesis 1b and Hypothesis1c respectively.

For the partially supported hypothesis, tests examined whether certain factors were significant for determining opportunities for IoT entrepreneurs in South Africa. Of the four factors – connected car, fleet management, cost savings and security of data – cost savings was the only factor not regarded as significant and, as a result, connected car, fleet management and security of data made up Hypothesis 2a.

Factors that determined the characteristics of successful entrepreneurs across resource-based capabilities, competitive strategies, product characteristics and market characteristics were shown to be the opposite of those for unsuccessful entrepreneurs. As a result, the study rejects the Hypothesis 1a.

Further discussions on the research hypotheses are provided in the subsequent sections.

5.4.1 Characteristics of Entrepreneurs

According to the literature review, most empirical studies that analyse success criteria in technology ventures share a certain commonality in terms of the measurements, which generally concentrate on the entrepreneur, the strategy and the product. Of the measurement models reviewed, Kakati's (2003) model was found to provide the most concise measuring criteria and caters for both high-tech and low-tech ventures. The study went on to state that entrepreneurs do in fact possess certain characteristics, which differ from those of non-entrepreneurs, However, this study does not indicate whether these characteristics differ in terms of successful and non-successful entrepreneurs, but merely indicates which of the characteristics lead individuals to become entrepreneurs. It was therefore theorised that, based on the literature, all entrepreneurs – whether successful or non-successful – will have similar characteristics, as it these characteristics, which include personality, affect and work ethic, that enable and empower them to begin the journey of entrepreneurship.

In contrast, the quantitative study showed that the characteristics of successful IoT entrepreneurs were different from those of unsuccessful entrepreneurs. This was, therefore, not in line with literature that all entrepreneurs, whether successful or unsuccessful, will have similar characteristics. As stated in the literature review, the success of entrepreneurs was looked at in terms of five key areas, namely entrepreneur characteristics, product characteristics, market characteristics, resource-based capability and competitive strategy.

The key characteristics of successful entrepreneurs include competence in the field of endeavour, the ability to evaluate and react well to risk, capability for sustained intense effort, creativity, enthusiasm / capacity for work, attention to detail, and familiarity with the target market. This is in contrast to unsuccessful entrepreneurs whose key characteristics include a lack of courage and the inability to react well to risk. Looking at the differences in characteristics, it makes business sense that entrepreneurs, particularly in start-ups, need to

have courage and be key risk-takers. As mentioned in the literature review, the main differences are rooted in the personality of the entrepreneur; thus, entrepreneurs tend to be more optimistic, have a higher risk-taking propensity, are more conscientious and have a higher locus of control (Chye Koh 1996).

In terms of product characteristics, the respondents indicated that the most important product characteristics of successful ventures are that the product enjoyed market acceptance and the product must be developed to functioning prototype. The respondents also indicated that none of these product characteristics were important to unsuccessful entrepreneurs. In contrast to the existing literature which states that product characteristics do not appear as critical as it was thought to be in the success of high-tech new ventures (Kakati 2003), respondents felt that a functioning prototype must be developed and the product must enjoy market acceptance for a venture to be successful.. Product uniqueness (which depends on research and development (R&D) intensity) was shown not be a significant factor in determining initial success, despite the tendency of high-tech firms to emphasise R&D and technological excellence. Once the product is designed and developed into a functioning prototype and enjoys some protection, it appears that further R&D intensity to make it a unique product is not necessary for initial success (Kakati 2003).

With regard to market characteristics, respondents indicated that the most important market characteristics of successful ventures are familiarity with industry structure and an untapped market potential. The respondents also indicated that unsuccessful entrepreneurs do not have any regard for the market characteristics that are highly valued by successful entrepreneurs. According to the existing literature, only two criteria, namely market growth rate and simulating existing market, are of significance. It appears that one can achieve initial success more easily and rapidly in the growing market and by stimulating existing markets instead of creating a new market. All other criteria in this category appear to have an insignificant influence on venture performance (Kakati 2003).

As for resource-based capabilities, the existing literature indicates that managerial capability (which consists of problem solving, decision making, employee retention, managing collaboration and networking, etc.) and technical capability (technology, technical expertise, and expertise in product development) are significant criteria for resource-based capabilities (Kakati 2003). The quantitative study found that for a venture to be successful, respondents believe that the most important resource-based capabilities are technical and managerial. In contrast, respondents believe that lack of managerial capability is the key characteristic of unsuccessful ventures. This finding is aligned with emerging technology where marketing and input sourcing is not as vital as the technical build-up of the solution and the management team driving the entity.

Finally, looking at competitive strategy, the existing literature states that competitive strategy, which is made up of quality, cost strategies, innovation and customisation strategies, is a significant factor in a successful high-tech venture (Kakati 2003). The quantitative study found that respondents identified quality strategy and innovation strategy as key factors for successful ventures.In contrast, respondents believe that unsuccessful entrepreneurs have low quality innovation strategies.

Overall, the results for a successful IoT entrepreneur is aligned to an emerging technology where the actual product, its market acceptance, technical capability and quality is more important than cost and marketing. In addition, tests that were run to determine the significance of similarities of factors between successful and unsuccessful ventures were rejected.

The above findings provide sufficient evidence to reject Hypothesis 1a.

5.4.2 Entrepreneur Ambitions

According to the literature, most studies focus on entrepreneur characteristics, with an emphasis on entrepreneur ambitions (Dhochak & Sharma 2014; Hall et al. 1993; Kakati 2003). As mentioned in the literature review, the Kakati (2003) model was used where the two key measures of entrepreneurial characteristics criteria, namely desire for success and capacity for work, relates to affect and work centrality respectively. Affect relates to moods, perceptions and cognitive processes. Entrepreneurs generally have more positive dispositions as entrepreneurs are assumed to be more optimistic about opportunities and ideas (Baron et al. 2011). Work ethic is also another crucial characteristic of an entrepreneur as it displays the degree of value the entrepreneur places on work diligence and efficiency (Weber 2002).

The quantitative study suggests that there is a significant relationship between affect and work centrality and desire for success and capacity for work respectively. As mentioned in the literature review, the characteristics pertaining to personality, affect and work ethic are what enable and empower people to begin the journey of entrepreneurship. In addition, enthusiasm to work was found to be more important than desire for success.

The above findings in relation to the literature review provides sufficient evidence to accept Hypothesis 1b.

5.4.3 Education is a Key Hindrance

As mentioned in the literature review, the GEM report shows that the main inhibitors of entrepreneurial activity in South Africa is the education system, social and cultural norms, financial support and government regulations and policies (Herrington et al. 2009). Throughout the GEM reports, key informants have consistently highlighted education and training as being one of the top three inhibitors of entrepreneurship in South Africa. According to the GEM report, lack of education has a direct negative impact on confidence and self-esteem, and also negatively affects creativity in a venture. Furthermore, the

report indicates that many South Africans are not afforded practical work experience in their chosen fields due to education and work restrictions placed by the apartheid regime.

The quantitative study suggests that there is a significant relationship between unsuccessful entrepreneurs and factors of creativity, courage and competence in the field of endeavour. It can also be concluded that the determinant, competence, in the field of endeavour is the main hindrance, followed by creativity and courage.

The above findings in relation to the literature review provides sufficient evidence to accept Hypothesis 1c.

5.4.4 Factors Affecting Opportunities for IoT Entrepreneurs in South Africa

The literature shows that IoT aims to revolutionise society and will have an impact on South African businesses and consumers. IoT opportunities traverse various industry sectors, such as healthcare, retail, agriculture and the automotive sector, providing ample opportunities for entrepreneurs in this emerging field. While there are opportunities for entrepreneurship in nearly every sector, the literature shows that the automotive sector is one of the most developed IoT sectors in South Africa, with this lead also extending to global markets. The iterature also shows that South African fleet management companies are at the forefront of this sector in the global marketplace.

While there are many reasons for the adoption of IoT, such as cost saving initiatives, process optimisation, and operational efficiencies, there are also various challenges which might inhibit the growth of IoT. Security is a key concern because if breaches occur, it could have major ramifications for both businesses and individuals.

The quantitative study suggests that there is a significant relationship between the benefits of IoT for organisations and the factors of fleet management, connected cars and security of personal data. As mentioned in the literature review, the opportunities offered by access to this connected car data will create new business models and enable greater service offerings on existing solutions from innovative entrepreneurs and existing businesses. Among the many industries already benefiting from this data are insurance companies, retail outlets, auto repair organisations, marketing and city planning. By having these vehicles connecting to the Internet in real time, information on location, speed, fuel levels, vehicle performance, music, etc. can easily be accessed. This information, combined with other consumer data, allows for targeted marketing and innovative offerings to meet the unique habits and requirements of customers (Kavis 2015). As literature indicates, the security and privacy of personal data is a major concern (Kocher 2014; Weber, 2010). In line with this, respondents believe that security is a significant hindrance to IoT opportunities for entrepreneurs.

Cost savings was the least significant factor. One of the possible reasons for this is that IoT is still in its early stages of development in South Africa. As a result, devices, network and data costs for communication between devices might still be too high for adoption. This might change in future as IoT becomes more prevalent. While there will be many early adopter companies which will embrace IoT solutions, mainstream businesses will require concrete use cases with proven ROI models before adopting new technologies (Kocher 2014).

Looking at the key factors for identifying entrepreneurship in South Africa, the key challenges for the use of IoT solutions, as mentioned by respondents, are connectivity, security and pricing which supports the abovementioned findings in relation to the literature review.

This provides sufficient evidence to partially accept Hypothesis 2a.

5.5 Conclusion

This chapter discussed and reflected on the findings of the literature review and the quantitative study. It validated the model to identify the key determinants of successful IoT ventures in South Africa and determining the current key vertical sector with the greatest opportunities for IoT entrepreneurs in South Africa. The chapter first presented an overview of the demographic profile of the respondents. This was done to ensure that the feedback obtained from the respondents was relevant and factual to the study. The chapter then provided a descriptive statistics discussion on determining the key factors, for identifying IoT entrepreneurship in South Africa. This set the stage for the research hypotheses discussion.

The hypotheses section provided a comparative discussion on what the quantitative study found and what the existing literature shows. From this, it was determined which hypotheses were fully supported (Hypothesis 1b and Hypothesis 1c), partially supported (Hypothesis 2a) and rejected (Hypothesis 1a) and how this was supported by literature.

Overall, the chapter addressed this study's first problem by identifying entrepreneur ambitions (desire for success and enthusiasm / capacity for work) and education (competence in the field of endeavour, courage and creativity) as key determinants of successful IoT ventures in South Africa. It addressed the second problem by identifying fleet management, connect cars and security as the key vertical sectors which provide the greatest opportunities for IoT entrepreneurs in South Africa.

CHAPTER 6. CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter provides a conclusion to the research study. The chapter begins with an overview of the main conclusions drawn. A discussion of the research contributions and implications of the study is then provided in terms of theory and practice. Finally, a review of future research directions is discussed.

6.2 Conclusions of the Study

The main conclusions drawn from the research study are based on the two main underlying research questions proposed in the literature review:

1. *What are the key determinants of success technology ventures in South Africa?*

The study found that the key factors of successful entrepreneurs, namely entrepreneur characteristics, product characteristics, market characteristics, resource-based capability and competitive strategy, are different to those of unsuccessful entrepreneurs. Key characteristics of successful entrepreneurs include competence in the field of endeavour, ability to evaluate and react well to risk, capability for sustained intense effort, creativity, enthusiasm / capacity for work, attention to detail and familiarity with the target market. This is in contrast to the key factors of unsuccessful entrepreneurs which include lack of courage and inability to react well to risk.

Entrepreneur ambitions (desire for success and enthusiasm / capacity for work) and education (competence in the field of endeavour, courage and creativity) are the key determinants of successful IoT ventures in South Africa.

2. *What are the key factors for identifying IoT entrepreneurshipin South Africa?*

IoT may be beneficial for business priorities in terms of innovativion, ensuring cost savings, creating new revenue streams, ensuring profitability and easily providing the means to go green. Other benefits include the ability to address in-house priorities more efficiently and effectively. The most beneficial IoT services to organisations are remote diagnostics and maintenance, asset tracking, energy data management, smart home solutions, connected cars and usage-based insurance. IoT has the largest impact on the human, retail environment, offices, cities, factories, vehicles and homes sectors.

Fleet management, connected cars and security are the key vertical sectors and provide the greatest opportunities for IoT entrepreneurs in South Africa.

6.3 Implications and Recommendations

This research, from an academic perspective, adds to the existing literature on IoT entrepreneurship in South Africa and the key success factors of new technology ventures in South Africa. By using current research to form the foundation of the study, the research built on the body of knowledge to further the understanding on the successes of IoT entrepreneurshipin South Africa. Moreover, the research, unlike other technology studies, investigated two components of technology entrepreneurship, namely key success factors of technology entrepreneurship in South Africa and key success sectors for IoT entrepreneurship in South African. More specifically, the study also assessed how the Kakati (2003) model worked in South Africa.

From a practical viewpoint, this research provides an analysis of the key determinants of successful IoT ventures in South Africa and the key vertical sectors which provide the greatest opportunities for IoT entrepreneurs in South Africa. This may be beneficial for various stakeholders, such as IoT solutions and service providers, IT and Telecommunications service providers, business

consumers and public organisations as it canhelp them make more informed decisions about their target market.

6.4 Suggestions for Further Research

Due to the ever-decreasing cost of technologies, it is expected that the cost of IoT technologies will decrease in future. As the technology matures, this will enable companies to acquire them at cheaper rates and, as a result, offer cost savings and improved efficiencies. This will impact the operational and financial performance of businesses. It is, therefore, recommended that future research re-test the cost savings factor as it could be a significant factor in determining opportunities for IoT entrepreneurs in South Africa.

Security is also another key factor that future research is recommended to test. This is due to the fact that the security of devices are important items on the agendas of companies. IoT security can be a study on its own, taking into account the extent and broad scope of the topic.

Finally, the factors that were identified to determine IoT entrepreneurship in South Africa were performed on a frequency basis and a descriptions statistics discussion was provided on these. It is recommended that future research test these factors to determine the causes of specific behaviours and motivations, and occurrence and causal relationships between these factors and IoT entrepreneurship.

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APPENDIX A

SECTION A: Demographics - Please select one answer to each question listed below

Q1 What is your current position within your organization?

- ❍ IT Manager / Director
- ❍ Telecom Manager
- ❍ Managing Director
- ❍ C-Level Executive (CEO/CIO/CTO)
- ❍ Other, please specify _____

Q2 Could you please tell me what best describes your involvement in IT and Communications strategy decision for your organization?

- ❍ I am a decision-maker
- ❍ I am an influencer

Q3 Could you please tell me how many permanent employees are there in your organization in South Africa?

- ❍ Less than 10 employees
- ❍ 10 to 49 employees
- ❍ 50 to 99 employees
- ❍ 100 to 249 employees
- ❍ 250 to 500 employees
- ❍ 500 to 999 employees
- ❍ 1,000 to 2,499 employees
- ❍ 2,500 to 4,999 employees
- ❍ 5,000 to 9,999 employees
- ❍ 10,000+ employees

Q4 Could you please tell me in which industry sector does your organization operate?

- ❍ Banking / Finance
- ❍ Energy / Oil & Gas
- ❍ Manufacturing
- ❍ Construction

- IT and Telecommunications
- Professional Services
- Government / Public Sector

Q5 Could you please tell me which of the following statements represents how ICT decisions are taken at your organization?

- ICT decisions are taken locally (within SA)
- ICT decisions are taken at our global headquarters (outside SA)

Section B (Part 1): Venture Success Criteria – Please rate importance of below listed factors in a SUCCESSFUL technology venture in South Africa where 1 = Highly unimportant and 5 = Highly important

Q6 Characteristics of Entrepreneurs

	1. Highly unimportant (1)	2. Marginally unimportant (2)	3. Neither important nor unimportant (3)	4. Marginally important (4)	5. Highly important (5)
Size of venture team (1)	❍	❍	❍	❍	❍
Desire for success (2)	❍	❍	❍	❍	❍
Creativity (3)	❍	❍	❍	❍	❍
Courage (4)	❍	❍	❍	❍	❍
Enthusiasm / capacity of work (5)	❍	❍	❍	❍	❍
Competence in field of endeavor (6)	❍	❍	❍	❍	❍
Capability of sustained intense effort (7)	❍	❍	❍	❍	❍
Ability to evaluate and react to risk well (8)	❍	❍	❍	❍	❍
Ability to articulate in the discussion (9)	❍	❍	❍	❍	❍
Attention to detail (10)	❍	❍	❍	❍	❍
Familiarity with the target market (11)	❍	❍	❍	❍	❍

Leadership quality (12)	❍	❍	❍	❍	❍
Track record that was relevant to venture (13)	❍	❍	❍	❍	❍

Q7 Resource based capability

	1. Highly unimportant (1)	2. Marginally unimportant (2)	3. Neither important nor unimportant (3)	4. Marginally important (4)	5. Highly important (5)
Managerial capability (1)	❍	❍	❍	❍	❍
Technical capability (2)	❍	❍	❍	❍	❍
Marketing capability (3)	❍	❍	❍	❍	❍
Input sourcing capability (4)	❍	❍	❍	❍	❍

Q8 Competitive Strategy

	1. Highly unimportant (1)	2. Marginally unimportant (2)	3. Neither important nor unimportant (3)	4. Marginally important (4)	5. Highly important (5)
Quality strategy (1)	❍	❍	❍	❍	❍
Cost strategy (2)	❍	❍	❍	❍	❍
Innovation strategy (3)	❍	❍	❍	❍	❍
Customisation strategy (4)	❍	❍	❍	❍	❍

Q9 Product characteristics

	1. Highly unimportant (1)	2. Marginally unimportant (2)	3. Neither important nor unimportant (3)	4. Marginally important (4)	5. Highly important (5)
Uniqueness of product / services relative to competitors (1)	❍	❍	❍	❍	❍
Protection of the product (2)	❍	❍	❍	❍	❍
Product enjoyed market acceptance (3)	❍	❍	❍	❍	❍
Product developed to functioning prototype (4)	❍	❍	❍	❍	❍
Product was in early stage of development (5)	❍	❍	❍	❍	❍

Q10 Market characteristics

	1. Highly unimportant (1)	2. Marginally unimportant (2)	3. Neither important nor unimportant (3)	4. Marginally important (4)	5. Highly important (5)
An untapped market potential (1)	❍	❍	❍	❍	❍
Access to well-established distribution channel (2)	❍	❍	❍	❍	❍
Market enjoying significant growth rate (3)	❍	❍	❍	❍	❍
Venture stimulates existing market (4)	❍	❍	❍	❍	❍
Familiarity with industry structure (5)	❍	❍	❍	❍	❍
Venture created a new market / segment (6)	❍	❍	❍	❍	❍

Section B (Part 2): Venture Success Criteria – Please rate importance of below listed factors in an UNSUCCESSFUL technology venture in South Africa where 1 = Highly unimportant and 5 = Highly important

Q11 Characteristics of Entrepreneurs

	1. Highly unimportant (1)	2. Marginally unimportant (2)	3. Neither important nor unimportant (3)	4. Marginally important (4)	5. Highly important (5)
Size of venture team (1)	❍	❍	❍	❍	❍
Desire for success (2)	❍	❍	❍	❍	❍
Creativity (3)	❍	❍	❍	❍	❍
Courage (4)	❍	❍	❍	❍	❍
Enthusiasm / capacity of work (5)	❍	❍	❍	❍	❍
Competence in field of endeavor (6)	❍	❍	❍	❍	❍
Capability of sustained intense effort (7)	❍	❍	❍	❍	❍
Ability to evaluate and react to risk well (8)	❍	❍	❍	❍	❍
Ability to articulate in the discussion (9)	❍	❍	❍	❍	❍
Attention to detail (10)	❍	❍	❍	❍	❍
Familiarity with the target market (11)	❍	❍	❍	❍	❍

Leadership quality (12)	❍	❍	❍	❍	❍
Track record that was relevant to venture (13)	❍	❍	❍	❍	❍

Q12 Resource based capability

	1. Highly unimportant (1)	2. Marginally unimportant (2)	3. Neither important nor unimportant (3)	4. Marginally important (4)	5. Highly important (5)
Managerial capability (1)	❍	❍	❍	❍	❍
Technical capability (2)	❍	❍	❍	❍	❍
Marketing capability (3)	❍	❍	❍	❍	❍
Input sourcing capability (4)	❍	❍	❍	❍	❍

Q13 Competitive Strategy

	1. Highly unimportant (1)	2. Marginally unimportant (2)	3. Neither important nor unimportant (3)	4. Marginally important (4)	5. Highly important (5)
Quality strategy (1)	❍	❍	❍	❍	❍
Cost strategy (2)	❍	❍	❍	❍	❍
Innovation strategy (3)	❍	❍	❍	❍	❍
Customisation strategy (4)	❍	❍	❍	❍	❍

Q14 Product characteristics

	1. Highly unimportant (1)	2. Marginally unimportant (2)	3. Neither important nor unimportant (3)	4. Marginally important (4)	5. Highly important (5)
Uniqueness of product / services relative to competitors (1)	❍	❍	❍	❍	❍
Protection of the product (2)	❍	❍	❍	❍	❍
Product enjoyed market acceptance (3)	❍	❍	❍	❍	❍
Product developed to functioning prototype (4)	❍	❍	❍	❍	❍
Product was in early stage of development (5)	❍	❍	❍	❍	❍

Q15 Market characteristics

	1. Highly unimportant (1)	2. Marginally unimportant (2)	3. Neither important nor unimportant (3)	4. Marginally importan (4)	5. Highly important (5)
An untapped market potential (1)	❍	❍	❍	❍	❍
Access to well-established distribution channel (2)	❍	❍	❍	❍	❍
Market enjoying significant growth rate (3)	❍	❍	❍	❍	❍
Venture stimulates existing market (4)	❍	❍	❍	❍	❍
Familiarity with industry structure (5)	❍	❍	❍	❍	❍
Venture created a new market / segment (6)	❍	❍	❍	❍	❍

Section C: IoT Business Opportunities & Challenges - Rate the importance on the below within your organization

Q16 What would you say are top business priorities for your organisation today?

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
Innovation (1)	❍	❍	❍	❍	❍
Cost saving (2)	❍	❍	❍	❍	❍
Creating new revenue streams (3)	❍	❍	❍	❍	❍
Profitability (4)	❍	❍	❍	❍	❍
Going Green (5)	❍	❍	❍	❍	❍

Q17 How is your organisation looking to address these priorities?

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
In-house (1)	❍	❍	❍	❍	❍
External (2)	❍	❍	❍	❍	❍

Q18 Which IoT services would be most beneficial to your organisation?

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
Fleet Management (1)	❍	❍	❍	❍	❍
Digital Signage (2)	❍	❍	❍	❍	❍
POS terminals and ticketing (3)	❍	❍	❍	❍	❍
Connected cabinets and vending machines (4)	❍	❍	❍	❍	❍
Energy data management (5)	❍	❍	❍	❍	❍
Asset tracking (6)	❍	❍	❍	❍	❍
Connected Car's (7)	❍	❍	❍	❍	❍
Usage based insurance (8)	❍	❍	❍	❍	❍
Remote diagnostics and maintenance (9)	❍	❍	❍	❍	❍
Smart home solutions (10)	❍	❍	❍	❍	❍
Asset tracking (11)	❍	❍	❍	❍	❍

Q19 In which sector do you perceive IoT having the largest impact in South Africa?

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
Human (1)	❍	❍	❍	❍	❍
Home (2)	❍	❍	❍	❍	❍
Retail environment (3)	❍	❍	❍	❍	❍
Offices (4)	❍	❍	❍	❍	❍
Factories (5)	❍	❍	❍	❍	❍
Vehicles (6)	❍	❍	❍	❍	❍
Cities (7)	❍	❍	❍	❍	❍
Environment (8)	❍	❍	❍	❍	❍

Q20 What are the key challenges experienced / perceived in the use of IoT solutions?

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
Security of personal data (1)	❍	❍	❍	❍	❍
Connectivity (2)	❍	❍	❍	❍	❍
Lack of clear RoI (3)	❍	❍	❍	❍	❍
Device or module challenges (4)	❍	❍	❍	❍	❍
Pricing (5)	❍	❍	❍	❍	❍
Quality of service (6)	❍	❍	❍	❍	❍

Q21 Indicate the largest impact of IoT technologies on your company's performance

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
Operational performance (1)	❍	❍	❍	❍	❍
Financial performance (2)	❍	❍	❍	❍	❍
Innovation (3)	❍	❍	❍	❍	❍
Security (4)	❍	❍	❍	❍	❍

Q22 An IoT entrepreneurial venture has many opportunities in South Africa

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
Do IoT entrepreneurs have opportunities in South Africa? (1)	❍	❍	❍	❍	❍

Thank you for the time and energy you have spent participating in this study. Your contribution has been most valuable! To stand a chance of winning the R1000 cash please enter your email address below. A winner will be selected at random on the 02 December 2015.