

The Potential use of the Internet of Things (IoT) in South African Retail Businesses

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The Department of Information Systems

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By

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ABSTRACT

Technology advancement has resulted in the creation of new paradigms such as the Internet of Things (IoT). The IoT is defined as the interconnectedness of devices or things through a path or network. The IoT is powered by Radio Frequency Identifiers (RFIDs), sensors, actuators, and the internet to enable an anytime, anyplace, with anything and anyone connection. The IoT is perceived as a major technological advancement in history, even though its enabling devices have been in existence for many years. The IoT is moving the digital world into an era where it will power billions of devices bringing about the transformation of products and services offered by businesses.

The IoT is predicted to change business processes by the year 2020 while 33% of South African businesses are set to invest in the IoT in the next 3 years. Businesses that will invest in the devices or things that make up IoT are expected to gain more and grow exceptionally well when compared to other businesses in that same market that are not using the IoT. The IoT is changing the retail industry by providing new opportunities to businesses and its customers creating new efficiencies in the business structures resulting in the increase in revenue.

The research took a subjective ontological stance with an interpretive view of reality using a deductive approach to theory employing the Technology Organisation Environment (TOE) Framework as a lens for the research. Data for this research was collected using a qualitative research approach using interviews as data collection method. For this research, heads of Information Technology (IT) were interviewed to answer the main research questions which included:

1. What is the potential use of IoT in South African retail businesses?
2. How can the South African retail environment potentially use IoT?
3. What are the potential benefits of using IoT in South African retail businesses?
4. What are the potential challenges of using IoT in South African retail businesses?

The findings revealed that retail businesses in South Africa are potentially looking at using the IoT for business processes in the coming years. Currently, retail businesses are not extensively using IoT as the devices and things that power the IoT are not widely available in South Africa. Other barriers that limit uptake is the cost of IoT devices in South Africa and bandwidth. However, respondents stated that the benefits of the IoT outweigh its challenges. The data further revealed that the Return on Investment (ROI) in the IoT will not be realised immediately. Retail businesses are looking at using the IoT for internal business processes rather than customer interaction. Retailers believe that the South African environment is not ready for a fully-fleshed IoT structure such as Amazon Go or Monoprix as the average South African is not technologically savvy. These findings support the TOE Framework that assumes that the technology, organisation, and environment are the driving forces behind a decision to innovate technologically.

Outputs from this research thus far include:

- **Publication Title:** A retrospective and prospective review of the use of the Internet of Things (IoT) in retail businesses: A Systematic Literature Review
Authors: Nomusa Nomhle Dlamini and Kevin Johnston
Publisher: International Journal of Control Theory and Applications 2017, 10(14), ISSN: 0974-5572 © International Science Press
- **Publication Title:** The Use, Benefits and Challenges of using the Internet of Things (IoT) in retail businesses: A Literature Review
Authors: Nomusa Nomhle Dlamini and Kevin Johnston
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DEDICATION

My dissertation is dedicated to the Lord God, He has been my source of strength through this journey. My dedication also goes out to my parents, my siblings, my family and friends for all the support, your prayers, words of encouragement and simply being a part of my journey.

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1 INTRODUCTION

Internet of Things (IoT) is the connection of object, devices or things through sensors, actuators and the internet (Dijkman, Sprenkels, Peeters, & Janssen, 2015). The sensors, actuators and the internet enable not only tracking of the objects, devices or things but also enable them to sense their surroundings and report to machines or humans (Dlodlo, 2012). These objects or “things” are enabled by networks to communicate (Gubbi, Buyya, Marusic, & Palaniswami, 2013).

In 2015, Andersson and Mattsson mentioned that the IoT is said to be one of the major advancement of technology in history because objects are now advancing from being computing devices moving into an era where they power billions of devices everyday. Therefore, the IoT is set to be the power behind the transformation of products and services offered by businesses (Gerpott & May, 2016).

IoT is expected to give rise to new opportunities for technology, giving birth to new applications and services that will leverage the opportunity it offers (Miorandi, Sicari, De Pellegrini, & Chlamtac, 2012). Businesses will envisage a world where people have access to an internet environment with self-configuring, self-managing smart technology that is available at anytime and anywhere (Nolin & Oslon, 2016).

For businesses, the IoT does not only provide effectiveness and efficiency, but also offers financial returns (Palattella, et al., 2016), the IoT further provides businesses with immense opportunities (Pang, Chen, Han, & Zheng, 2015). Technology is changing the business environment, creates new competition and businesses that survive in the ever-changing environment are those businesses that anticipate these changes and develop ideas, products and services that will meet these future demands (Caputo, Marzi, & Pellegrini, 2016). The ability of a business to sense the market that they are in and its opportunities are essential to sustaining and developing a competitive advantage. Technology innovation increases businesses’

ability to enter and create new markets, which in turn adds to its success (Caputo, et al., 2016).¹

1.1. PURPOSE OF THE STUDY

The purpose of this research is to explore the potential use of the IoT in South African retail businesses. The research placed primacy on the potential of the IoT in retail businesses in South Africa and the following objectives will be achieved:

1.1.1 Research Objectives

1. To explore the potential use of the IoT in South African retail businesses.
2. To explore how the South African retail environment can potentially use the IoT.
3. To explore the potential benefits of using the IoT in South African retail businesses.
4. To explore the potential challenges of using the IoT in South African retail businesses.

The above considerations were anticipated to provide answers on the potential use of IoT in South African retail businesses by answering the research questions that follow:

1.1.2 Research Questions

Research Question 1:

What is the potential use of the IoT in South African retail businesses?

Research Question 2:

How can the South African retail environment potentially use the IoT?

¹ Parts of this section was adapted from Research Design submitted 28 October 2016

Research Question 3

What are the potential benefits of using the IoT in South African retail businesses?

Research Question 4

What are the potential challenges of using the IoT in South African retail businesses?

1.1.3 Main problem

Technology has been advancing over the years, moving the world to new paradigms such as the IoT (Coetzee & Eksteen, 2011; Gubbi, et al., 2013). Mzekandaba (2016) suggested that about 33% of businesses in South Africa will invest in IoT in the next three years while Tully, Friedman, Lheureux, Geschickter, and Hung, (2016) predict that by the year 2020 business processes will change offering to the interconnectedness of devices and things. Businesses that are set to use the IoT will gain more and grow exceptionally as compared to other businesses in the same market, provided they are willing to change their business processes and structure (Geschickter, Kutnick, Velosa, Perkins, & Steenstrup, 2015; Tully, et al., 2016).

Gregory (2015) stated that the IoT is reshaping the retail industry, offering new opportunities to businesses and its customers. The rise of competition in the retail market has resulted in more and more retail businesses using IoT to gain market share (Longo, Kovacs, Franke, & Martin, 2013). The IoT offers businesses the ability to be more efficient and effective and thus increasing their revenue. For example, the IoT enables automated checkouts, which will potentially cut the number of cashiers by 75%, resulting in a profit of \$150 billion to \$380 billion a year in 2025 (Manyika, et al., 2015). The IoT provides businesses with the ability to enter and create new markets and in turn increase their competitive advantage (Caputo, Marzi, & Pellegrini, 2016).

Coetzee and Eksteen (2011) and Dijkman, Sprenkels, Peeters, and Janssen, (2015) argued that for businesses to fully realise the benefits offered by the IoT they

will need to overcome its challenges. Security and Privacy remain the greatest challenges posed by the use of the IoT (Tully, 2016; Weber, 2015).

1.1.4 Sub-problems

The first sub-problem is to explore the potential use of the IoT in South African retail businesses.

The second sub-problem is to explore how the South African retail environment can potentially use the IoT.

The third sub-problem is to explore the potential benefits of using the IoT in South African retail businesses.

The fourth sub-problem is to explore the potential challenges of using the IoT in South African retail businesses.

1.2 RATIONALE

Technology has been advancing with the years and the world is moving towards a paradigm where things will be always connected (Coetzee & Eksteen, 2011), this has given way to new paradigms such as IoT, which connects all things that surround us through a network (Gubbi, et al., 2013).

Alternatively, retail businesses are finding it important to understand the behaviours of their customers, especially when they are in-store, for the provision of better services, improvement in customer experience in-store, increase sales and profit (Yaeli, et al., 2014).

The IoT is said to impact the way normal activities are carried out (Pang, et al., 2015) and provide a variety of benefits for businesses such as enabling various functions that include security, tracking and tracing, payment, etc. (Andersson & Mattsson, 2015). The IoT is going through a growth expansion (Dijkman, et al., 2015), successively offering a gateway to link businesses to the virtual world, which was not possible before (Khan, Khan, Zaheer, & Khan, 2012).

The Industrial Development Corporation (IDC) of South Africa stated that 33% of South Africa's businesses are planning on investing in IoT in the next three years (Knight, 2016). The corporation further highlighted that due to the high growth of the IoT and the opportunities it provides, retailers will need to rethink their business process (Knight, 2016).

1.3 RESEARCH METHOD

The research took a subjective ontological stance with an interpretive view of reality using a deductive approach to theory employing the Technology Organisation Environment (TOE) Framework as a lens for the research. Data for this research was collected using a qualitative research approach using interviews as data collection method. For this research, heads of Information Technology (IT) were interviewed to collect data (Bhattacharjee, 2012; Saunders, Lewis, & Thornhill, 2009).

1.4 CONTEXT OF THE STUDY

"With the rapid advancements in Information Technology (IT) in the last decade, the Internet of Things (IoT) is becoming conspicuous in our daily life" (Balaji & Roy, 2017, p. 1). IoT is defined as "A world where physical objects are seamlessly integrated into the information network, and where the physical objects can become active participants in business processes" (Haller, Karnouskos, & Schroth, 2008, p. 3).

Retail businesses are using IoT to offer in- and out-store experience for their customers (Kahlert, 2016). The IoT combines various different technologies that interact with each other to offer businesses various opportunities (Atzori, Iera, Morabito, & Nitti, 2012). The IoT is largely driven or enabled by Radio Frequency Identifiers (RFIDs), among other technologies. Murray, Papa, Cuzzo, and Russo, (2016) argued that the IoT is an incremental and combinative innovation as it uses already existing technologies to create new products and services that are more dynamic and efficient than the existing ones.

It is imperative to state that the IoT offers retail businesses the ability to enable automated checkouts, smart shelves that can detect stock levels, ability to guide customers directly to the items they are looking for in-store, real-time pricing and sale adverts based on the product demands, information on customers' purchase behaviour to offer products they are more likely to purchase, etc. (Bok, 2016; Gregory, 2015).

1.5 ASSUMPTIONS AND LIMITATIONS

- The study assumed that the respondents in this research will have enough knowledge on the use of the IoT, its benefits and challenges to be able to clearly answer the questions.
- The assumption was that the people who are more likely to have answers to this research were C-Level management in IT as they are considered the key decision-makers with regards to technology in businesses (Davis & McDonagh, 2014).
- The study focused on retail businesses in South Africa, this means that other business types were excluded.
- The study used purposive sampling to select large retail businesses in South Africa with the assumption that they have considered or are considering using the IoT within their business (Barratt, Ferris, & Lenton, 2015).

1.6 SIGNIFICANCE OF THE STUDY

The study will provide guidance to Chief Information Officers (CIOs), Chief Technology Officers (CTOs) or Head of Information Technology (IT) in South African retail businesses on how they can potentially use the IoT in their businesses. The study further provides guidance on the theoretical factors that contribute to the potential use of the IoT in South African retail businesses.

1.7 ETHICS AND ETHICAL CONSIDERATIONS

All responses for this research were kept anonymous, no identifying information was requested from respondents. The research was approved by the UCT Ethics committee. Further ethics and ethical considerations are detailed in 3.9.

1.8 DEFINITION OF TERMS

Retail Business is defined according to the Standard Industrial Classification (SIC) of all economic activities in South Africa, as businesses that buy new or used goods from other businesses or manufacturers for resale to the general public without transforming or altering the goods (Lehohla, 2012). Retail businesses include café, general dealers, grocery stores, speciality stores, exclusive boutiques, chain stores, department stores, supermarkets, cash and carry wholesale-retail outlets and cooperative stores in rural areas.

Potential use is defined as a key method to improve the business competitive advantage by means of technology (Alonso-Almeida & Llach, 2013; Venkatesh, Thong, & Xu, 2012). Venkatesh, et al. (2012) further mentioned that the use or the potential use of technology is largely driven by the notion that the technology will provide benefits that were not there before, giving the business a competitive advantage over other businesses in the same market.

1.9 STRUCTURE OF DISSERTATION

The next chapter focuses on the Literature Review which outlines the literature findings, how the research questions were formulated and the research framework for this research. Chapter 3 outlines the Research Methodology, Design and Processes, as well as the Epistemological and Ontological assumptions. Chapter 4 presents the Analysis and Findings. Chapter 5 concludes by providing the Summary, Discussion and Recommendations.

2 LITERATURE REVIEW

2.1 INTRODUCTION

The growing use of the internet has changed the way retail businesses conduct their everyday business processes (Bok, 2016). The purpose of this literature review was to identify studies, case studies, and models used to explore the potential use of the Internet of Things (IoT) in South African retail businesses. The literature review defined key terms, definitions and terminology related the potential use of the Internet of Things (IoT) in South African retail businesses to answer the following the main research questions:

1. What is the potential use of the IoT in South African retail businesses?
2. How can the South African retail environment potentially use IoT?
3. What are the potential benefits of using IoT in South African retail businesses?
4. What are the potential challenges of using IoT in South African retail businesses?

Geschickter, et al. (2015) stated that the IoT is set to be the enabling force behind the digital future. Further, according to Weber (2015, p. 618) “the Internet of Things (IoT) as an emerging global Internet based information architecture that facilitates the exchange of goods and services is gradually gaining importance”. Implementing the IoT in retail offers various advantages to businesses and innovative ways to interact with its customers (Porkodi & Bhuvanewari, 2014; Firdausi, 2016; Kahlert, 2016).

The IoT is used to provide devices, objects or things with an anytime, anyplace, with anything and anyone connection through a network or path and any service (Guo, Zhang, Wang, Yu, & Zhou, 2013; Perera, Zaslavsky, Christen, & Georgakopoulos, 2014). The IoT encompasses an environment that is made up of things, communication, applications and data analysis (Jones, 2015). Figure 1 illustrates a high-level structure of the IoT. The User Interface (UI) which forms the

²presentation layer of IoT devices that a user uses to interact with; the application logic and rules which encompasses the backend code that enables the function and smartness of the devices; data which is the data produced by the devices and analytics which analyses the data produced (LeHong, 2016).

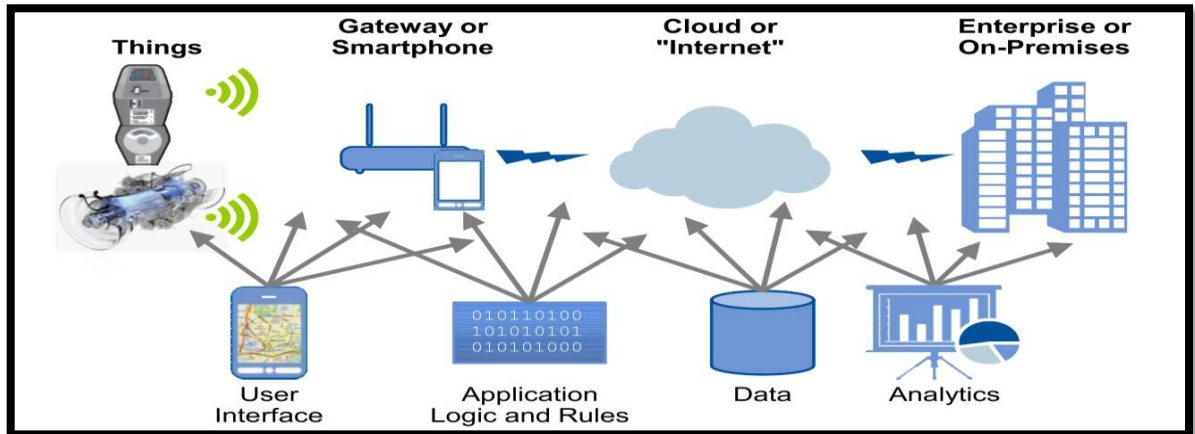


Figure 1: High-level architecture for the IoT (LeHong, 2016, p. 4).

Gregory (2015) argued that IoT is perceived as a disruptive technology in the retail environment. Retailers use the technology to leverage opportunities such as connecting devices to create new services in improving customer experience, optimising supply chain operations, and to create new opportunities to generate revenue.

Jiang and Su (2013) also argued that the connection of the IoT devices, objects or things have resulted in cost reduction, technological development and industrial upgrading, enabling better supply chain management in retail businesses, intelligent transportation, and modern logistics. Subsequently, the importance of using RFIDs has grown within retail businesses where they are used for inventory management, logistics and transportation, assembling and manufacturing, asset tracking and object location, and environment sensor, among other things (Sarac, Absi, & Dazere-Peres, 2010).

² Parts of this section was adapted from Literature Review submitted 25 July 2016

This Literature Review is structured as follows:

Section 2.4 discusses THE USE OF IOT IN RETAIL BUSINESSES and the issues that surround the use of IoT.

Section 2.5 highlights THE BENEFITS OF USING IOT IN RETAIL BUSINESSES.

Section 2.6 provides THE CHALLENGES OF USING IOT IN RETAIL BUSINESSES, examining the most common challenges presented in the literature.

Section 2.7 presents the proposed THEORETICAL FRAMEWORK, thereafter conclusions are drawn.

Section 2.8 presents the FUTURE DIRECTIONS of IoT in retail businesses.

2.2 SEARCH METHODOLOGY

The search methodology followed Garrido, Sey, Hart, and Santana (2012) which was conducted as follows:

Resources for executing the search: A combination of databases was used to conduct the literature review. The primary databases that were used to gather literature included Google Scholar and UCT online library database. From the UCT online library, databases which were searched included EBSCO Host, Emerald and Science Direct.

Type of Literature: Selected academic journals, academic books, conference papers, business reports and articles.

Publication Date: The dates of publication that were considered ranged from 2012 to 2017, with a few considerations of older literature.

Language: Even though the researcher is multilingual, the search for literature was limited to English language texts only because a majority of academic research is written in English (Garrido, Sey, Hart, & Santana, 2012).

Key search terms: keywords that were used in the search included but not limited to: “Internet of Things”, “the use of IoT in businesses”, “e-tailing”, “the potential use of IoT in retail businesses”, “benefits of IoT in businesses”, “potential benefits of IoT in retail businesses”, “challenges of IoT in businesses”, “potential challenges of IoT in retail businesses”, “conducting a literature review”, “information systems”.

2.3 BACKGROUND DISCUSSION

According to Parwekar (2011, p. 329) “Kevin Ashton of Massachusetts Institute of Technology (MIT) is considered the father of the concept ‘Internet of Things’ which was coined in 1999”. By definition, the IoT connects people and things anytime, anyplace, with anything or anyone, through a path or network and a service (Perera, Zaslavsky, Christen, & Georgakopoulos, 2014).

Atzori, et al. (2012) defined IoT has the integration of various technologies that have the ability to work with each other to achieve a common goal. Feretti and Schiavone (2016), defined the IoT as a dynamic global network infrastructure that is equipped with self-configuring capabilities.

On the notion that the IoT is seen as a disruptive technology in the retail environment. Retailers are using the technology to leverage opportunities such as connecting devices to create new services to improve customer experience, optimise supply chain operations, and creating new opportunities to generate revenue (Gregory, 2015).

According to Zancul, et al. (2016, p. 306) “IoT is defined as a new paradigm in which things or objects provided with radio frequency identification, tags, sensors, actuators, etc. – through unique addressing schemes- being able to interact with each other and cooperate with their neighbours to reach common goals.” However, Bello, Zeadally, and Badra (2016) defined IoT as a paradigm that facilitates the

exchange of information between devices and human through an internet connection.

For the purposes of this research, IoT will be defined as “A world where physical objects are seamlessly integrated into the information network, and where the physical objects can become active participants in business processes” (Haller, et al., 2008, p.3). This definition met the purposes of this research as the research seeks to explore the potential use of IoT in retail businesses, which will pay close attention to the business processes within the retail business.

2.4 THE USE OF IOT IN RETAIL BUSINESSES

Manyika, et al. (2015) stated that business processes in retail businesses have changed significantly with each year and IoT is set to cause more significant changes. For example, with the use of IoT, customers can be guided directly to the item they want to purchase when they enter a store using a connection enabled by IoT devices and the customers mobile phone (Manyika, et al., 2015). IoT devices in retail businesses create new business models, improve productivity, reduce costs and increase sales (Manyika, et al., 2015).

Sarac, et al. (2010) argued that the IoT technologies are used in retail businesses because of their ability to uniquely identify products, ease of communication and their ability to provide real-time information. Longo, Kovacs, Franke, and Martin (2013) further mentioned that with the rise of competition in the retail market, more and more retailers are using the IoT to gain market share. It is worth noting that IoT technologies have changed the amount of data available to a business as well as the accessibility to that data, businesses can easily gather data about their customers and their behaviour by using the IoT (Parry, Brax, Maull, & Ng, 2016).

Dlodlo (2012) and Gubbi, Buyya, Marusic, and Palaniswami (2013) submitted that the IoT uses sensors, actuators and the internet to enable tracking of objects, devices or things and sense their surroundings through the aid of a network. The primary objective of IoT is to share information between the objects, devices or things, to create a cognitive environment (Zhang & Wen, 2016). With RFIDs as the

key enabler of the IoT technologies, it enables automatic identification of objects, devices and things (Bardaki, Kourouthanassis, & Pramadari, 2012).

Moreover, per Geschickter, et al. (2015) about 70% of businesses globally will use the IoT for internal business processes through 2020. Using IoT for business transforms business processes from being performed by humans to being performed by machines. In general, for businesses, the IoT solutions are created to support functionalities such as management and connectivity (Perera, Liu, & Jayawardena, 2015).

An IoT driven business transforms the physical business processes into efficient digital processes, as the IoT enables businesses to digitise, sell and deliver physical assets more virtually (Brody & Pureswaran, 2015). The IoT can be used to improve business process efficiencies, reduce the cost of warehouse logistics as well as in service industries (Murray, Papa, Cuzzo, & Russo, 2016).

Retail businesses use IoT to optimise their store layout by installing sensors that track the movements of customers to identify aisles with the highest traffic thus, placing goods on those aisles to increase purchases (Bok, 2016). Alternatively, retail businesses use data received from the IoT devices to gather information about their customers' behaviour and use that information to recommend products that the customer is more likely to purchase (Dasgupta, Nagaraj, & Nagamani, 2016; Gregory, 2015).

Further, retail businesses use the IoT to help customers find products that they are looking for in the store (Firdausi, 2016; Gregory, 2015), this process is enabled by IoT technologies that have the ability to track and locate products to help the customer find those products easier (Bok, 2016). Retail businesses also install the IoT devices on their shelves that notify the supply department when products are running out, alternatively, businesses can use IoT to assess the quality of their products, this is more popular within supermarkets because they keep fresh produce (Gregory, 2015; Tiwari & Dewangan, 2015). In this view, "consumer-centric solutions, platforms, data management, and business models have to be developed

and consolidated in order to deploy effective solutions in specific fields” (Verikoukis, et al., 2017, p. 108).

However, LeHong (2016) argued that for businesses to select a successful IoT architecture they will need to consider; the **cost** of the hardware, software and data that make up IoT architecture, the **connectivity and technical requirements** which ensure that the IoT architecture is reliable, the service is of quality, connection distance between devices etc., **data and security** to ensure that reliability of the IoT architecture and **user and implementation** to ensure that the user needs are met, this is detailed in Figure 2.

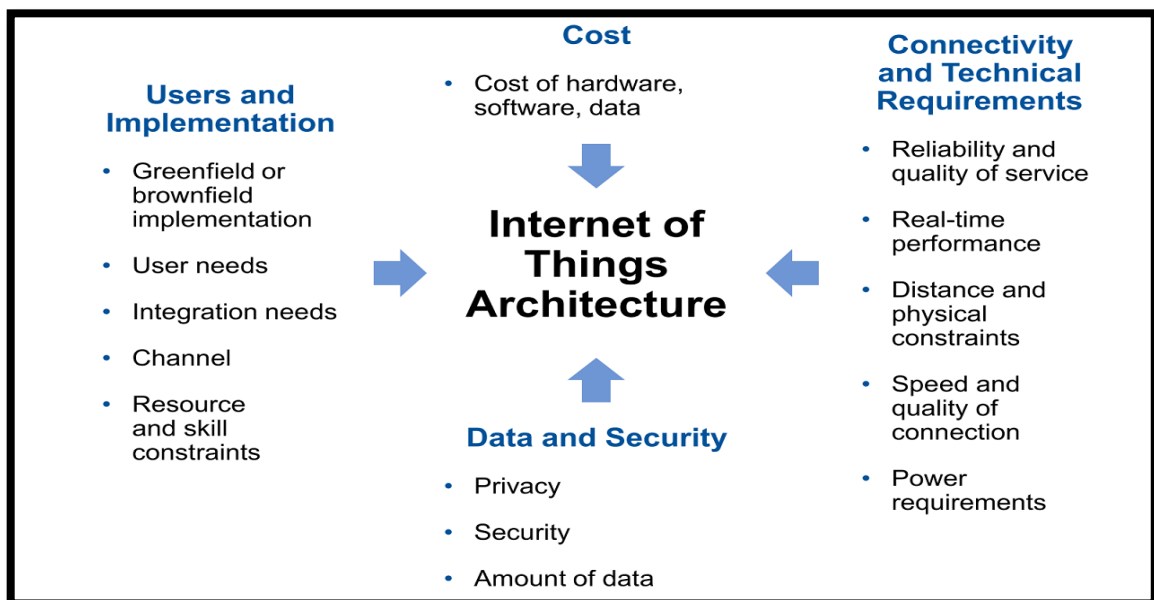


Figure 2: Internet of Things Architecture (LeHong, 2016, p. 16).

2.4.1 Technologies used for IoT

The key components that make up the IoT are RFID systems, which are made up of readers, which trigger transmission of signals and tags, and are equipped with unique identifiers in the objects, tags, sensors, and actuators (Atzori, Iera, & Morabito, 2010; Zancul, et al., 2016). Bi, Da Xu, and Wang (2014) further discussed that the important technologies in IoT include RFIDs and WSNs and secondary to these technologies are ubiquitous computing and cloud computing.

However, Atzori, et al. (2010) contended that there are many technologies that exist which enable IoT, and these technologies work together to offer IoT its capabilities, as shown in Figure 3. The three paradigms illustrate how the IoT is made up; Internet Oriented includes all the middleware technologies such as RFIDs, WSNs, Near Field Communication (NFC), etc., Things Oriented are IoT sensors which include the Internet Protocol for Small Objects (IPSO) etc. and finally Sematic-Oriented which is the knowledge of IoT and these include semantic technologies, reasoning over data (Atzori, et al., 2010; Gubbi, et al., 2013).

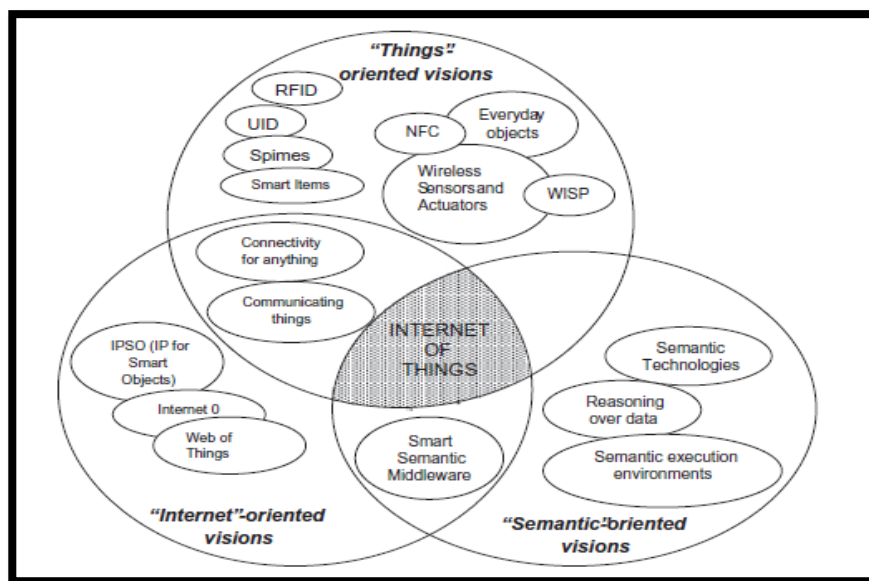


Figure 3: Technologies that make up the IoT (Atzori, Iera, & Morabito, 2010, p. 2789).

The IoT technologies provide a variety of benefits to businesses because they cover wide areas, enabling many functions such as security, tracking and tracing, payment, etc. (Andersson & Mattsson, 2015; Murray et al., 2016). It is therefore important for businesses to know which technologies or a combination of technologies are best to use in the business to harvest the opportunities the IoT provides (Andersson & Mattsson, 2015). The IoT is not a single technology, but different technologies that are connected to achieve a common goal or perform a dedicated function (Balaji & Roy, 2017).

Popular examples of IoT include; wearables that monitor personal health, security access cards, devices to track stolen cars, identity tags for retail goods. In business,

some examples include tracking systems for solving or preventing problems like sending cell phone alerts to drivers about traffic to increase efficiency or remotely switching off the power in the office once the building has been vacated (Dlodlo, 2012).

These examples show that the IoT comes in different forms, therefore, CIOs, operational teams and chief digital officers (CDOs) can use the architectural differences to build IoT solutions that are best suited for their businesses (LeHong, 2016). Geschickter, et al. (2015) highlighted that the IoT technologies used by customers, such as wearables, can be connected to the businesses and used to gather data from their customers increasing the pool of information available about customers.

However, most IoT technologies are not a complete set needed to build an IoT business solution, the technologies still need to be configured, modified and integrated with back-end systems and data to build an IoT solution best suited for their businesses as discussed by Velosa, et al. (2015). Similarly, the uses and technologies of IoT are changing at a fast rate resulting in the growth of IoT opportunities for businesses as further articulated by Tully, Friedman, Lheureux, Geschickter, and Hung (2016).

2.4.2 Business Processes enabled by IoT in retail

Geschickter, et al. (2015) asserted that if businesses use or plan to use IoT they will have to plan for the reinvention of their business processes. Servitisation is a term that has been established to refer to the trend of moving from a purely product delivery to more integrated business solutions where service is the leading role (Kujala, et al., 2011).

Several businesses still run the same business processes in a traditional way. However, this limits the impact of the IoT on the business (Geschickter, et al., 2015). The IoT is set to automate business processes and make them easier (Bi, Da Xu, & Wang, 2014). Businesses that are using IoT are using the technology to run their complex operations and enabling their systems to make autonomous decisions

based on the data and sensor reports delivered by these systems (Bughin, Chui, & Manyika, 2013). For businesses to fully harness IoT, they will need to move from their traditional business processes and adapt to new business models that will fully incorporate IoT and then the business will start seeing the value proposition of IoT.

Check outs are one of the biggest processes in retail businesses, which can be time-consuming and costly to business (Bok, 2016). Retail businesses can, therefore, use IoT to optimise this process allowing for automated check-out processes where customers do not need to stand in lines to pay for purchased goods, but they can be charged automatically when they walk out the store, reducing labour costs and cutting the time a customer spends in the store (Gregory, 2015; Tiwari & Dewangan, 2015).

More examples of business processes enabled by IoT include; pay-as-you-drive insurance, machine uptime as a service, smart lighting, usage-based jet engine services and remote healthcare, also noting that new processes emerge each day (Tully, et al., 2016).

This leads to research the first and second research questions.

2.4.2.1 Research Question 1

What is the potential use of IoT in South African retail businesses?

2.4.2.2 Research Question 2

How can the South African retail environment potentially use IoT?

2.5 THE BENEFITS OF USING IOT IN RETAIL BUSINESSES

In 2016, Murray et al. stated that IoT is a paradigm in which innovation creates value, by enabling intelligence and communication between humans and machines, while providing a new way of communication and transfer of information. “Information technology is increasingly considered as an enabler of business competitive advantage in addition to its contribution to satisfying customers’ demand of innovative and qualitative products and services” (Bok, 2016, p. 2).

The undeniable and basic benefit of using the IoT is its ability to impact and potentially change the everyday processes of its use (Atzori, et al., 2010). The IoT offers the ability for businesses to access information about physical objects that are not easily available, provides more information to businesses which could lead to innovation, high efficiency and productivity (Bi, et al., 2014).

Geschickter, et al. (2015) argued that most of the benefits offered by the IoT will be seen internally in the businesses, introducing terms such as the “Intranet of Things”, which is a process where IoT uses algorithms to gather data for business value. Furthermore, IoT technologies produce large amounts of information and data that was not previously available in the business (Zancul, et al., 2016), such as customer profiles or customer behaviour which informs businesses about the activities of their customers’ that can be used in the business to improve marketing strategies in enabling awareness of the customer preferences and can recommend products that the customer is most likely to purchase, increase in business revenue and the market of IoT analytics (Geschickter, et al., 2015; Solima, Della Peruta, & Maggioni, 2016).

Caputo, Marzi and Pellegrini (2016) added that the IoT technologies enable retail businesses to trace their products and enable the business to monitor their products with the information received from the IoT technologies. Businesses can, in turn, ensure production efficiency as there is a consistent flow of information between the business and the supplier. Retail businesses have a variety of products that they sell and IoT technologies improve the supply chain management of those

products and reduce the complexity of the amount of data the business handles and the transactions performed (Caputo, et al., 2016).

Benefits that the IoT offers include the reduction of data acquisition costs because devices, objects, machines or things work together and share resources; availability of previously unavailable data as IoT technologies will have the ability to interact with humans and real-time data for decision-making. This is the case because IoT provides data in real time from different machines, objects or things that are connected and helps the business to make decisions quicker (Perera, et al., 2015). Geschickter, et al. (2015) also identified efficiency improvement, asset optimisation, physical premises, equipment security and safety improvement as benefits offered by IoT. Through innovation provided by IoT in business, businesses can enter and create new markets and increase their competitive advantage (Caputo, et al., 2016).

This leads to research the third research question.

2.5.1.1 Research Question 3

What are the potential benefits of using IoT in South African retail businesses?

2.6 THE CHALLENGES OF USING IOT IN RETAIL BUSINESSES

Zimmer (2008) and Geschickter, et al. (2015) argue that as much as technology, like IoT, undeniably benefits businesses in various ways, it also presents challenges to businesses. Furthermore, Caputo, et al. (2016) argues that studies have shown that businesses that continuously innovate stand a better chance of survival. From a business perspective, general challenges that businesses should consider include automation, manufacturing, logistics, business or process management of people and things (Atzori, et al., 2010).

For businesses to fully reap the benefits of IoT, they will need to overcome its challenges and more as the number of connected things is escalating with each passing year (Coetzee & Eksteen, 2011; Dijkman, et al., 2015). Security and privacy remain the most important issues of IoT and are the centre of trust, relationship building and exchange (Weinberg, Milne, Andonova, & Hajjat, 2015).

2.6.1 Security challenges

Tully (2016) stated that security challenges posed by using the IoT remain one of the greatest challenges to businesses. The increase in the use of the IoT inevitably increases data attacks on the new devices (O'Neill, 2014). An example of businesses that have had their security compromised and had customer information conceded include; Anthem, Apple, Home Depot, JP Morgan Chase, Sony, and Target (Weinberg, et al., 2015).

In this regard, security is a major challenge which businesses will need to overcome to effectively use technologies such as the IoT (Roman, Zhou, & Lopez, 2013). The security of IoT technologies is seen as a complex task because there is a connection of billions of devices and as more devices are connecting, there is an increase in the potential attacks of IoT technologies. These attacks can affect communication channels, through physical threats, Denial of Service (DoS), identity fabrication, among others (Roman, et al., 2013).

Weber (2013) submitted that businesses feel that a protection framework is adequate to ensure the security of IoT, but on the other hand, individuals feel that more needs to be ensured with regards to privacy and security of IoT, such as data confidentiality, integrity and availability. If IoT security is compromised businesses are at the risk of facing cost implications because the IoT devices are connected to other devices and if security is breached at one point, a lot of devices are at risk. Therefore, businesses need to ensure that their security is well secure when using IoT (Weinberg, et al., 2015).

Roman, et al. (2013), argued that there need to be ways to achieve universal authentication of IoT technologies. Singh and Perkins (2015) agreed with this notion and stated that effective authentication will facilitate secure links between devices, applications and people. Singh and Perkins (2015) further argued that effective authentication will ensure the secure flow of data between IoT devices while also ensuring device integrity.

Jones (2016) further argues that there is a need for security technologies that will protect IoT devices and platforms from security challenges such as information attacks and physical tampering. Jones (2016) further argued that these devices can aid in encrypting the communication of IoT devices and address potential challenges such as impersonating “things” or denial-of-sleep attacks that drain batteries.

2.6.2 Privacy challenges

“Privacy is defined as a process of anonymity preservation and so it is strongly connected with control over information about the self” (Taddei & Contena, 2013, p. 822). Weber (2015) emphasised that the IoT technologies receive and send large amounts of data between devices and therefore are prone to a high-risk when it comes to the privacy of data.

Data privacy remains one of the major challenges of IoT, the data that is used by different connecting devices creates trust and privacy issues (Trequattrini, Shams, Lardo, & Lombardi, 2016). Businesses need to ensure that they can ethically keep

customer information private and that their customers are not forced to reveal information about themselves to others by using the IoT (Caron, Bosua, Maynard, & Ahmad, 2016). Privacy challenges can be overcome by using service agreements between the business and its customers as well as technological advancement, i.e. bug fixes (Weber, 2015). Newe (2015) further highlighted that encryption can be used to protect the data produced by the IoT technologies at the application level protecting sensitive data and access to this data using mandates such as Payment Card Industry Data Security Standard (PCI DSS) which is ideal for retail businesses.

2.6.3 Network challenges

The increase in the use of the IoT technologies poses capacity and bandwidth challenges causing failures in the networks (Newe, 2015). Current traditional networks do not provide technical features and operational cost for the IoT devices that require wide-area coverage and low bandwidth, good battery life, low hardware and operating costs, and high connection density (Jones, 2016).

Roman, et al. (2013) further highlighted that there could be either internal and external attacks on the network of the IoT as attackers cannot control the whole connection. These attacks include, but not limited to DoS: which are attacks on the service provider resources and network bandwidth; eavesdropping, where the attacker passively targets the communication channels in the data flow with the aim of extracting data from the channel and node capture. These are prone to attackers where the attacker targets data processing or data storage entities (Roman, et al., 2013).

On the other hand, selecting the right wireless network for IoT also presents challenges with regard to conflicting requirements such as range, battery life, bandwidth, density, endpoint cost and operational costs (Jones, 2016).

2.6.4 Governance challenges

According to Geschickter, et al. (2015) less than 1% of businesses that use the IoT have governance policies in place in the business. Weber (2011) defined

governance, according to the Working Group on Internet Governance (WGIG) as rules, principles, norms, decision-making procedures and programs that manage the evolution of the internet.

The use of the IoT technologies in businesses elevates governance challenges; this could be infrastructure governance or general regulations (Trequattrini, et al., 2016). The IoT technologies need to ensure interoperability, the right of access, the robustness of the infrastructure and reliability of the devices. Notably, governance Legislation pose limits on the use of IoT and a single legislation cannot yet be developed to govern its use (Weber, 2013).

Further, Roman, et al. (2013) argued that the size and heterogeneity of the IoT devices affect its governance and trust. Governance of IoT offers interoperability mechanisms, but also the governance of these technologies can create an over-controlled environment, thus limiting innovation (Roman, et al., 2013; Trequattrini, et al., 2016).

Weber (2011) additionally stated that the governance of IoT will generally relate to the governance of the internet, however, Geschickter, et al. (2015) stressed that it is important for businesses to implement governance policies for the IoT data when using the IoT technologies.

This leads to the fourth research question.

2.6.4.1 Research Question 4

What are the potential challenges of using IoT in South African retail businesses?

2.7 THEORETICAL FRAMEWORK

The Technology Organisation Environment (TOE) theoretical framework was used as a lens to study the potential use of the IoT in South African retail businesses (Ngwenyama & Nielsen, 2003). TOE has been widely used to study different technologies that make up IoT such as RFIDs and Cloud Computing (Chan & Chong, 2013). TOE has three underlying paradigms that determine the adoption and implementation of innovations, these are the technological context, organisational context and environmental context (Borgman, Bahli, Heier, & Schewaki, 2013), as shown in Figure 4.

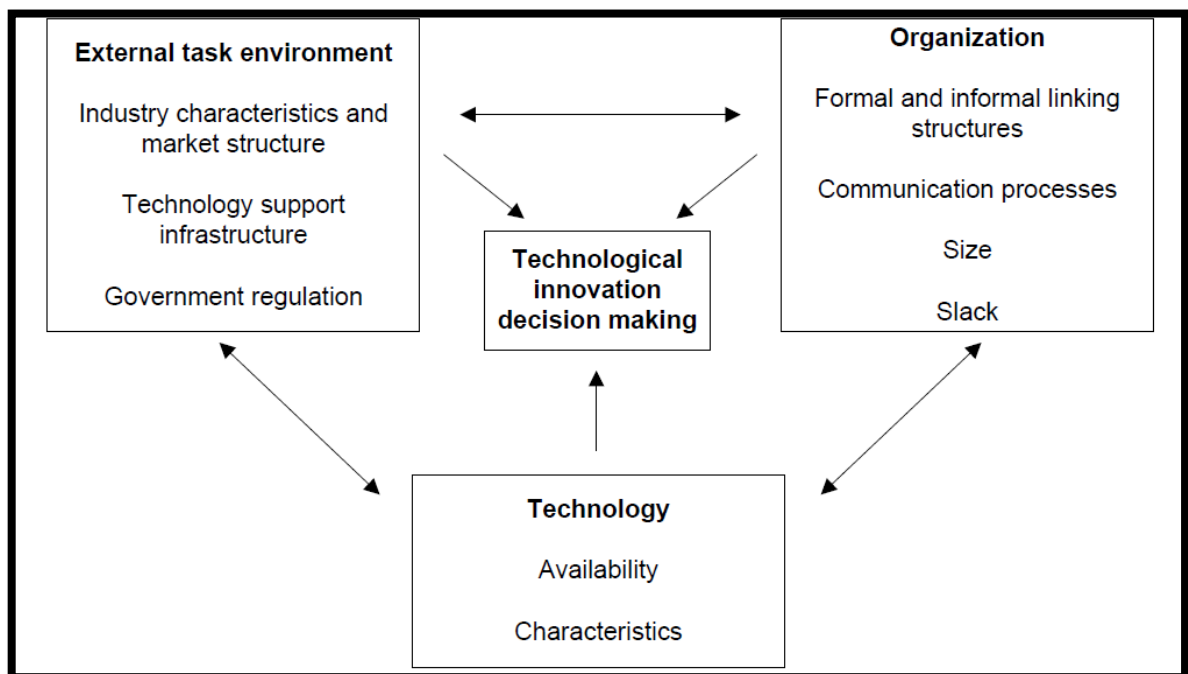


Figure 4: TOE Framework (Oliveira & Martins, 2010, p. 112).

2.7.1 Technological Context

The technological context refers to all the external and internal technologies available to the businesses (Gutierrez, Boukrami, & Lumsden, 2015). “These technologies can be those that the business owns and those technologies available in the business market” (Khosrow-Pour, 2013, p. 131). The technological context includes both the structural aspect and the specialised human resources in the business (Oliveira, Thomas, & Espadanal, 2014). The structural aspects of

businesses consider the platform or the technological infrastructure within the business. Specialised human resources, on the one hand, consider the people in the business that have knowledge and skill to use IoT. For this research, technology referred to IoT technology (Gutierrez, et al., 2015).

Equally, for business to efficiently use IoT, the business Information Technology (IT) infrastructure will need to change to integrate different functions over different platforms (Bi, et al., 2014). IoT changes business processes, from warehousing to retail delivery and store shelving and is providing a more accurate and real-time visibility of the flow of materials and products (Lee & Lee, 2015).

2.7.2 Organisational Context

The organisational context refers to the business characteristics such as the scope, size, trust, managerial structure, technology readiness, the quality of human resources and a number of slack resources available in the business (Oliveira, et al., 2014; Gutierrez, et al., 2015). This construct fits the definition of the research as the research considered the organisation as retail businesses.

Businesses that will successfully change their processes to incorporate IoT will need to secure support from all the business functions, product development, marketing, sales, operations, and finance because this will require collaborative management between all functional business departments (Storbacka, 2011). Moving to a more service-based business model will offer the business the opportunity for extending their market scope (Kindström, 2010).

2.7.3 Environmental Context

The environmental context refers to the market in which business operates and includes the industry, competitors, access to resources and the dealings with the government (Khosrow-Pour, 2013). For the purposes of the research, the environmental context was South Africa.

Geschickter, et al. (2015) argued that businesses need to consider the environment in which they are in, the barriers that may limit the use of IoT to set out plans for businesses to effectively use IoT. Longo, et al. (2013) further stated that a growing number of retail businesses are using IoT in their stores to improve customer experience. Therefore, retail businesses are now able to monitor the behaviours of their customers; with this, they can market the products that the customer is likely to be interested in. There is no doubt that with the use of IoT, businesses can extend their business processes and add new products and services and in turn offer additional benefits to its customers (Caputo, Marzi, & Pellegrini, 2016; Gerpott & May, 2016).

2.8 FUTURE DIRECTIONS

Tully, et al. (2016) predicted that by the year 2020 every role in a business structure will be changed by IoT as over 20 billion things will be connected and technologies that are currently consumer-centric will be used by businesses and vice versa. More predictions are illustrated in Figure 5.

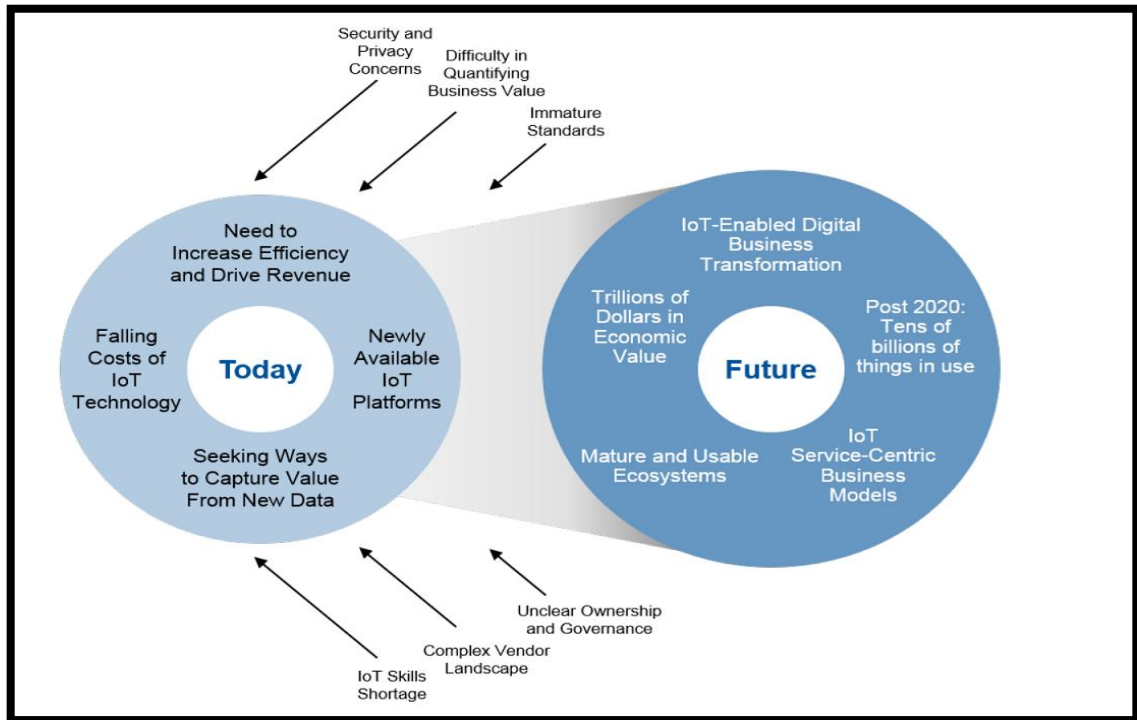


Figure 5: Internet of Things overview (Tully, Friedman, Lheureux, Geschickter, & Hung, 2016, p. 2).

Businesses that use IoT aim to reduce costs, improve efficiency and create new business models through physical products, services and data analysis, however, the impact of IoT differs among businesses (Tully, et al., 2016). Industries such as retail, utilities and manufacturing anticipate that IoT will have a noticeable impact on their businesses as compared to other industries such as government, education, insurance and banking (Jones, 2015).

2.9 CONCLUSION TO LITERATURE REVIEW

“The Internet of Things (IoT) is the network of physical objects (things) that contain embedded technology to sense or interact with their internal state or external environment” (Jones, 2015, p. 2). Businesses that use IoT are set to gain from the use of IoT and grow exceptionally compared to other businesses in the same market provided they are willing to change their business structure and processes (Geschickter, et al., 2015; Tully, Friedman, Lheureux, Geschickter, & Hung, 2016).

On the other hand, Jones (2015) identified that senior executive and business unit leaders lack the understanding of IoT, retail falls on the higher end of such businesses and this impact on the business ability to harness the potential of IoT, presented in Figure 6.

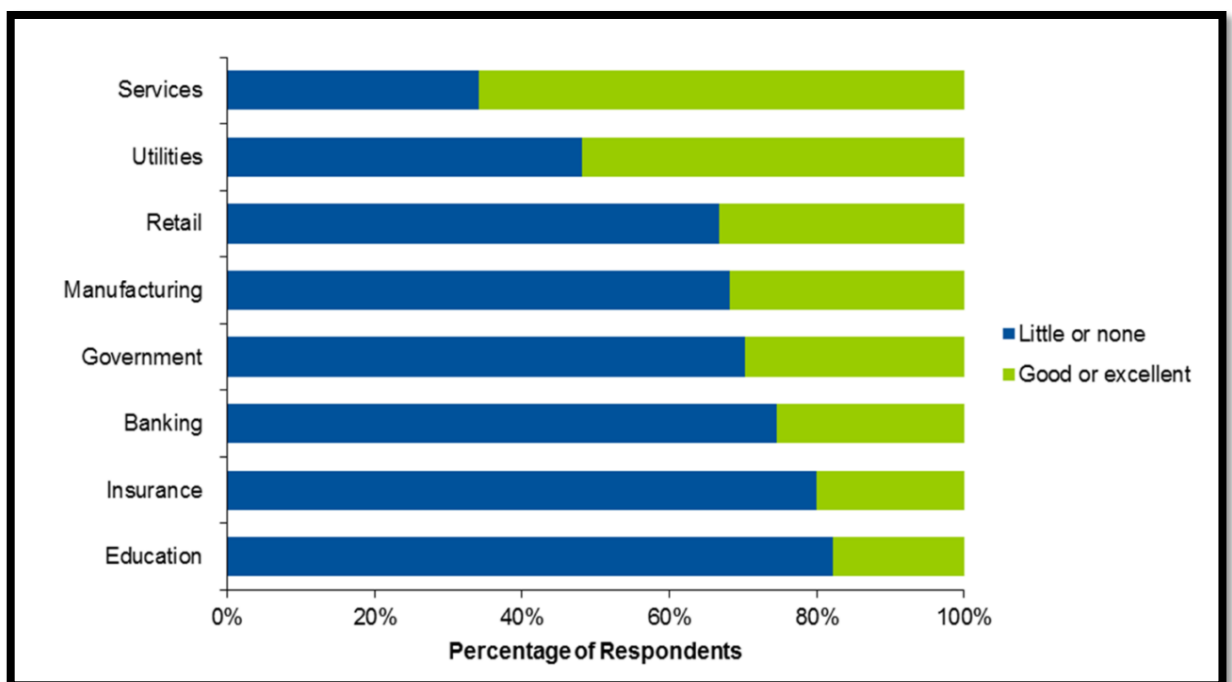


Figure 6: Senior executive and business unit leader's understanding of IoT (Jones, 2015, p. 8).

Additionally, with the increase in the use of IoT, businesses will need to acquire new data centres that are flexible and scalable to support the escalation (Rao, Cappuccio, & Rhame, 2016). Wallin, Jones, and Kleynhans (2015) argued that a stand-alone IoT strategy may add value, but greater value is realised when the IoT

strategy is incorporated within a business-wide digital strategy. “For many organisations, the IoT will be a cornerstone of their digital business strategies, but will also be very disruptive, requiring them to master many new technologies and capabilities” (Jones, 2016, p. 2).

2.10 IDENTIFIED GAPS IN LITERATURE

The following are the gaps that were identified in the literature review:

1. About 70% of businesses around the world will use IoT for internal business processes from now to 2020. However, it was not mentioned how many SA retail businesses will fall into the trend and whether this data true for South African businesses?
2. The literature reviewed assessed the benefits and challenges of using IoT in retail businesses, however, the literature reviewed did not assess the benefits and challenges of using IoT in South African retail business – that is whether these benefits and challenges are true in the South African business context.
3. Jones (2015) highlighted that senior executive and business unit leaders lack an understanding of IoT. However, the literature review did not assess if this is true in the South African context.

3 RESEARCH METHODOLOGY

This section outlines the methodology that was followed to answer the research questions that were constructed to answer the main research problem and sub-problems identified in the Literature Review Section. The section will discuss different consideration to illustrate why the method was chosen.

This section is structured as follows:

Section 3.1 presents the ontological stance that will be taken for this research.

Section 3.2 presents the epistemological stance of the research.

Section 3.3 outlines the research design covering the research approach and method.

Section 3.4 discusses the research process, presenting the procedure for data collection, research instrument, population and sampling.

Section 3.5 discusses the data analysis and interpretation of the research.

Section 3.6 discusses the pilot study.

Section 3.7 confers the limitation of the study.

Section 3.8 discusses the validity and reliability of the research.

Section 3.9 concludes the section by discussing the ethics and ethical considerations of the research.

3.1 ONTOLOGY

Ontological questions in social science research are related to the nature of reality (Tuli, 2010). Ontology is how the researcher sees the world. Saunders, Lewis, and

Thornhill (2009) stated that the two main ontological stances in research are objectivism and subjectivism. ³

A researcher can have a social order view of the world, which means that they study patterns of ordered events or behaviours, thus believing that the best way to gain knowledge is through an objective approach, therefore, adopting a functionalist paradigm (Bhattacharjee, 2012). Alternatively, a researcher can hold a subjective interpretation of the participants thus believing that the best way to gain knowledge is through interacting with the participants by interviewing them and analysing the data gathered therefore leading to an interpretivism paradigm (Bhattacharjee, 2012).

The research took a subjective ontological stance. The researcher held the view that the best way to gain knowledge and in-depth understanding of the potential use of IoT in South African retail businesses is through interacting with participants by interviewing them.

3.2 EPISTEMOLOGY

The epistemology of a research stems from the ontological stance the researcher has chosen. Epistemology drives the way a researcher comes to know what they know, i.e. epistemology motivates how the researcher gathers knowledge (Cater-Steel, 2008; Grix, 2002; Killam, 2013).

There are two main epistemological stances in research; positivism and interpretivism (Grix, 2002). Positivism assumes that the best way to gather knowledge is through an objective approach to reality, thus being independent of human consciousness (Morris, 2009). Interpretivist believe that the best way to gather knowledge is through a subjective approach to reality. An Interpretivist interacts with the participants to gather knowledge; reality about knowledge is

³ Parts of this section was adapted from Research Design submitted 28 October 2016

gathered through making sense of the world of the respondent and their goals (Walsham, 1995; Weber, 2004).

The research took an interpretivist stance. The aim of the research was to understand the interpretations and meanings of the potential use of IoT in South African retail businesses to get in-depth insights on the subject (Klein & Myers, 1999; Walsham, 1995). Therefore, an interpretive view of reality fitted the definition of the research.

3.3 RESEARCH DESIGN

3.3.1 Research Purpose

The purpose of research is to discover something new and useful. This could be a new modelling technique, an advancement of existing modelling technique or new insight into a particular modelling approach, environmental problem or physical process (Maier, 2013). The purpose of the research can be exploratory, descriptive or explanatory (Bhattacharjee, 2012). Exploratory research is used to study a new problem or phenomenon. The purpose of an exploratory research is to explore a new phenomenon and its dynamics, report on the phenomenon and to identify further research on that phenomenon. Descriptive research observes a phenomenon and gives a description or report of that phenomenon (Saunders, Lewis, & Thornhill, 2009). The purpose of explanatory research is to give explanations of the phenomenon that is studied (Bhattacharjee, 2012). The difference between descriptive research and explanatory research is that; descriptive research seeks to answer the 'what', 'where' and 'when' questions about the phenomenon while explanatory research answers the 'why' and 'how' questions about the phenomenon (Bhattacharjee, 2012; Saunders, Lewis, & Thornhill, 2009).

This study explored the potential use of IoT in South African retail businesses; thus, considered a new phenomenon. The main objectives of the study were to; explore the potential use of IoT in South African retail businesses; determine the potential benefits of using IoT in South African retail businesses; investigate the potential

challenges of using IoT in South African retail businesses and examine how the South African retail environment can use IoT; therefore, an exploratory research method was taken for this research (Bhattacharjee, 2012; Saunders, et al., 2009).

3.3.2 Approach to Theory

Approach to theory may take an inductive and deductive reasoning (Bhattacharjee, 2012). An inductive approach seeks to gather facts or observed evidence and drawing conclusions from them (Saunders, et al., 2009). Conclusions drawn from an inductive research are often derived from hypotheses that still need to be proven, therefore, commonly referred to a theory-building research (Bhattacharjee, 2012; Creswell, 2013). A deductive approach aims to test an existing and proven theory. Deductive research draws conclusions about a phenomenon or problem using a theoretical or logical reasoning, therefore, referred to as a theory-testing research (Saunders, et al., 2009). Both research approaches aim to advance knowledge (Bhattacharjee, 2012).

The research used the TOE Framework to study the potential use of IoT in South African retail businesses, thus taking a deductive approach to theory (Bhattacharjee, 2012; Creswell, 2013). The purpose of the study was not to build new theory but rather to explore artefacts of a theoretical framework that were identified in the literature review survey (Bhattacharjee, 2012).

3.3.3 Research Approach

Creswell (2013) stated that there are three approaches to research. These are qualitative, quantitative, and mixed methods. “Depending on the type of data collected (quantitative or qualitative), data analysis may be quantitative (e.g., employ statistical techniques such as regression or structural equation modelling) or qualitative (e.g., coding or content analysis)” (Bhattacharjee, 2012, p. 23).

Qualitative research is defined as an approach to exploring and understanding the individual or groups view of the research problem (Creswell, 2013). A qualitative research approach is considered a non-numerical data collection, e.g., interviews,

or data analysis, and categorising data technique, this can include text data, pictures or video clips (Bhattacharjee, 2012; Saunders, et al., 2009). However, qualitative data can also be represented using quantitative research methods. Qualitative research is predominately associated with interpretive research, this is because like interpretivism, qualitative research aims to interpret and make sense of social reality (Bhattacharjee, 2012).

Quantitative research is defined as a theory testing approach used to objectively to explore relationships defined by those theories among variables (Creswell, 2013). A quantitative research approach is considered numerical data collection technique that uses data collection technique such as a questionnaire or a data analysis procedure such as graphs or statistics (Bhattacharjee, 2012; Saunders, et al., 2009). Quantitative research is predominately associated with a positivist research (Bhattacharjee, 2012).

Bhattacharjee (2012) stated that qualitative and quantitative research approaches do not exist in isolation, a researcher can use more than one data collection and analysis technique to answer the same research question. Mixed methods research is defined as research that employs both qualitative and quantitative research methods to answer a research question (Creswell, 2013; Saunders, et al., 2009). Mixed methods are perceived to give the researcher a deeper insight of the research problem (Creswell, 2013). Mixed methods do not combine qualitative and quantitative research methods, but rather uses these methods, parallel or sequential (Saunders, et al., 2009).

This study used a qualitative research approach to explore the potential use of IoT in South African retail businesses (Creswell, 2013; Saunders, et al., 2009). Qualitative research assisted the researcher to explore hidden, interrelated social processes of the research problem and uncover interesting and relevant issues or ideas through having a subjective interaction with the respondents (Bhattacharjee, 2012).

3.3.4 Data Collection Method

“Data is collected in interpretive research using a variety of techniques. The most frequently used technique is interviews (face-to-face, telephone, or focus groups)” (Bhattacharjee, 2012, p. 107). Interviews can be open-ended/unstructured, semi-structured or focused/structured (Saunders, et al., 2009).

Unstructured interviews give the respondents an opportunity to answer the questions in their own way; they are considered an informal way of conducting an interview (Bhattacharjee, 2012; Porkodi & Bhuvanewari, 2014). In an unstructured interview, the interviewer does not have a list of questions to ask, but an idea they would like to explore (Saunders, et al., 2009). Unlike unstructured interviews, semi-structured interviews are a non-standardised form of interview where the research has a list of questions to ask but has a flexibility of asking follow-up questions or omitting questions to get an in-depth understanding of a theme or question (Saunders, et al., 2009). Structured interviews are considered a standardised form of inquiry. Structured Interviews require the respondent to give their answers based on the choices of answers given, e.g., questionnaire (Bhattacharjee, 2012; Saunders, et al., 2009).

The study adopted semi-structured interviews as the data collection method, which made use of electronic (Video Calling) and face-to-face interviews (Bhattacharjee, 2012). This research used semi-structured interviews to gain an in-depth understanding of the questions or themes to be able to uncover new ideas and themes (Saunders, et al., 2009).

3.4 RESEARCH PROCESS

3.4.1 Research Instrument

The proposed research instrument for this study was semi-structured interview questions. The interview questions were guided by the literature review and theoretical framework (Saunders, et al., 2009). Detailed questions are found in Appendix 1. The interviews are categorised using the theoretical framework. i.e.

The interview questions include questions about the Technology, Organisation and Environment as guided by the TOE Framework (Oliveira, et al., 2014).

3.4.2 Population

Bhattacharjee (2012, p. 65) defined a population as “all people or items (unit of analysis) with the characteristics that one wishes to study. The unit of analysis may be a person, group, organization, country, object, or any other entity that you wish to draw scientific inferences about”.

This study used the case of retail businesses in South Africa as the research population. The reason the study chose retail businesses, which represents a subset of the types of businesses in South Africa, is because retail businesses globally are using the IoT to leverage its opportunities (Gregory, 2015). The Council for Scientific and Industrial Research (CSIR) South Africa stated that IoT is of importance and will potentially impact the society, economy and environment (Coetzee, 2011).

3.4.3 Sample and sampling method

According to Bhattacharjee (2012, p. 65) “sampling is the statistical process of selecting a subset (called a ‘sample’) of a population of interest for purposes of making observations and statistical inferences about that population”.

Sampling is divided into two categories; probability sampling and non-probability sampling (Bhattacharjee, 2012; Saunders, et al., 2009). Probability sampling is often referred to as random sampling, where every participant in the population has an equal chance to be chosen. Examples of probability sampling include simple random sampling, systematic sampling, stratified sampling, cluster sampling, matched-pairs sampling and multistage sampling (Bhattacharjee, 2012). Non-probability sampling is a non-random sampling technique which gives the participants a zero chance to be selected. Examples of non-probability sampling include convenience sampling, quota sampling, expert sampling, purposive sampling and snowball sampling (Saunders, et al., 2009).

Purposive sampling was used to select large retail businesses in South Africa (Barratt, Ferris, & Lenton, 2015; Tongco, 2007). Purposive sampling is defined as a sampling technique that allows the researcher to choose participants that are deemed to have answers to the research questions or meet the research objectives (Saunders, et al., 2009), thus purposive sampling was employed for this study.

The study sampled Head of IT in retail businesses in South Africa as they are assumed to be key decision-makers in business technology strategies (Davis & McDonagh, 2014). The number of participants was 12 interviews. This was the point where the point of saturation was reached (Boddy, 2016).

3.5 DATA ANALYSIS AND INTERPRETATION

Data analysis and interpretation aim to give meaning to the data collected to make it useful (Bhattacharjee, 2012; Saunders, et al., 2009). Data analysis and interpretation in qualitative research can be conducted using Content Analysis, Thematic Analysis, Grounded Theory, Hermeneutic Analysis, etc. (Bhattacharjee, 2012; Ezzy, 2013).

Content Analysis uses quantitative or qualitative methods to systematically analyse the content of the text, such as newspaper stories, financial reports, blog postings, online reviews, etc. (Bhattacharjee, 2012). Whilst, Thematic Analysis aims to identify, analyse and interpret patterns or themes in the data that is collected and make sense of them, highlighting core or recurring issues (Ezzy, 2013; Rohleder & Lyons, 2014). Grounded Theory is “an inductive technique of interpreting recorded data about a social phenomenon to build theories about that phenomenon” (Bhattacharjee, 2012, p. 113). Ezzy (2013) stated that Grounded Theory and Thematic Analysis use the same techniques for data analysis, but the difference is that Grounded Theory uses theoretical sampling and Thematic Analysis does not. Lastly, Hermeneutic Analysis is also a similar technique as content analysis, but unlike content analysis, Hermeneutic Analysis employs a subjective approach within a socio-historic context (Bhattacharjee, 2012).

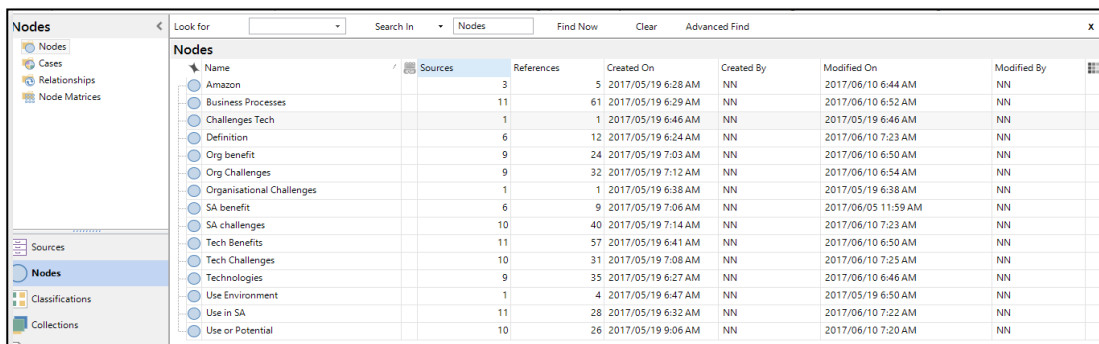
The data collected from this research was analysed using Thematic Analysis to identify themes that emerge from the data (Braun & Clarke, 2006; Marks & Yardley, 2004). The analysis followed Braun and Clarke (2006) six steps of conducting Thematic Analysis:

1. Familiarise or immerse in data

Data was collected using interviews, audio recording was used to store the respondents' answers. After each interview, the audio recordings were transcribed turning the results into text data. The data was transcribed manually by the researcher, no software was used for transcription (Saunders, et al., 2009). The data was then read and re-read, thus immersing the researcher in the data to familiarise with the data (Rohleder & Lyons, 2014).

2. Coding the data

The data was coded to identify codes, which are key ideas or issues from the data (Rohleder & Lyons, 2014). Data analysis can be conducted by using Computer Aided Qualitative Data Analysis Software (CAQDAS) such as NVivo™, ATLAS.ti™, N6™, HyperRESEARCH™, QDA Miner, and other similar software (Bhattacharjee, 2012; Saunders, et al., 2009). For this research NVivo™ was used to code the data. NVivo™ codes the data using Nodes which groups the data into themes, illustrated in Figure 7.



Name	Sources	References	Created On	Created By	Modified On	Modified By
Amazon		3	5 2017/05/19 6:28 AM	NN	2017/06/10 6:44 AM	NN
Business Processes		11	61 2017/05/19 6:29 AM	NN	2017/06/10 6:52 AM	NN
Challenges Tech		1	1 2017/05/19 6:46 AM	NN	2017/05/19 6:46 AM	NN
Definition		6	12 2017/05/19 6:24 AM	NN	2017/06/10 7:23 AM	NN
Org benefit		9	24 2017/05/19 7:03 AM	NN	2017/06/10 6:50 AM	NN
Org Challenges		9	32 2017/05/19 7:12 AM	NN	2017/06/10 6:54 AM	NN
Organisational Challenges		1	1 2017/05/19 6:38 AM	NN	2017/05/19 6:38 AM	NN
SA benefit		6	9 2017/05/19 7:06 AM	NN	2017/06/05 11:59 AM	NN
SA challenges		10	40 2017/05/19 7:14 AM	NN	2017/06/10 7:23 AM	NN
Tech Benefits		11	57 2017/05/19 6:41 AM	NN	2017/06/10 6:50 AM	NN
Tech Challenges		10	31 2017/05/19 7:08 AM	NN	2017/06/10 7:25 AM	NN
Technologies		9	35 2017/05/19 6:27 AM	NN	2017/06/10 6:46 AM	NN
Use Environment		1	4 2017/05/19 6:47 AM	NN	2017/05/19 6:50 AM	NN
Use in SA		11	28 2017/05/19 6:32 AM	NN	2017/06/10 7:22 AM	NN
Use or Potential		10	26 2017/05/19 9:06 AM	NN	2017/06/10 7:20 AM	NN

Figure 7: Nodes.

3. Identify themes

At this stage, the related codes were grouped together to create themes, which give meaning to the identified codes (Rohleder & Lyons, 2014), this was also done using NVivo™ as illustrated in Figure 8.

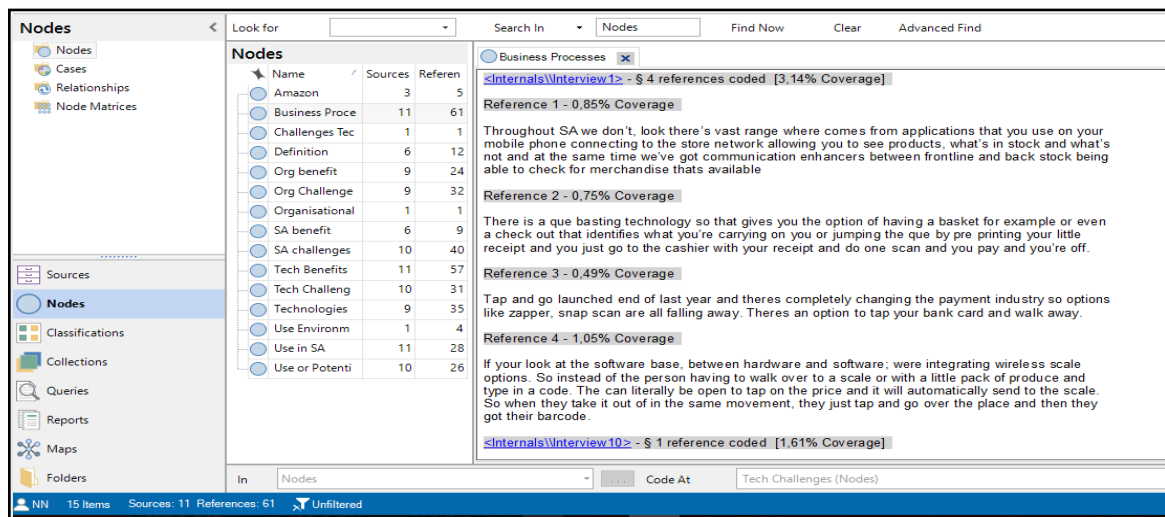


Figure 8: Themes.

4. Review themes

Reviewing themes is a process where the themes were checked to ensure that they are relatable to the research. This was done by; reviewing the themes against the codes and developing a story and reviewing the themes against the data collected to ensure that they reflect the data (Rohleder & Lyons, 2014).

5. Define and name themes

At this stage, each theme focuses and scope was refined to create a meaningful interpretation of the data (Rohleder & Lyons, 2014).

6. Write up

Last, but not least, the analysis was polished, thus giving a detailed interpretation of the data and significance, and the analysis was contextualised in relation to the theoretical framework (TOE) (Rohleder & Lyons, 2014).

3.6 PILOT STUDY

The main aim of pilot testing is to identify and refine problems with the research instrument and approach to data collection (Saunders, et al., 2009). “Pilot testing is an often overlooked but extremely important part of the research” (Bhattacharjee, 2012, p. 23).

The research instrument was first checked by the research supervisor to determine if the questions were adequate for the study. This helped to identify errors or ambiguity in the questions before the first pilot interview (Saunders, et al., 2009). After the questions were approved, the first two interviews were treated as a pilot study to compare and determine:

- How long the interview takes to complete;
- If questions are clear and not ambiguous;
- If there are questions the respondents are uncomfortable answering;
- Any issues or themes that might have been omitted
- And other possible issues that arise from the interviews.

3.7 LIMITATIONS OF THE STUDY

“Virtually all research has its limitations” (Saunders, et al., 2009, p.538). Identified limitations of this research are as follows:

- Limited experience of the researcher to conduct research.
- The research aimed to work with Head of IT in business and therefore time constraints was an issue in the research as respondents chosen had busy schedules (Myers & Newman, 2007).

- The researcher had difficulty accessing the respondents as the researcher did not have any form of relationship with the respondents (Myers & Newman, 2007).
- The study only considered retail businesses which are a subset of the type of businesses in South Africa, thus the findings may not relate to all business types.
- The research considered Heads of IT in South African retail businesses; their views might differ from Heads of IT in other countries.
- Individuals sampled might not have all the information required on the subject.

3.8 VALIDITY AND RELIABILITY

Bhattacharjee (2012, p. 58) argued that “validity, often called construct validity, refers to the extent to which a measure adequately represents the underlying construct that it is supposed to measure”. Whilst Saunders, et al. (2009, p.156) stated that “reliability refers to the extent to which your data collection techniques or analysis procedures will yield consistent findings”). In qualitative research validity and reliability are measured by transferability, credibility, dependability and confirmability (Bhattacharjee, 2012).

3.8.1 Transferability

Transferability is defined as the extent in which the findings of the research can be generalised (Bhattacharjee, 2012). The research ensured that the sample selected will be representative of the population to ensure transferability of research findings (Malterud, 2001). The researcher used different methods to find research subjects, such as LinkedIn to obtain a representative sample.

3.8.2 Credibility

Credibility is defined as the extent of the findings are true, this can be demonstrated through data triangulation, verbatim transcription of interviews, accurate records of contacts and interviews, clear notes on theoretical and methodological decisions and other forms that ensure data credibility (Bhattacharjee, 2012). The research ensured that respondents were in a managerial position in the IT space and are currently working with identified large retail businesses in South Africa (Cutcliffe & McKenna, 1999). To ensure credible responses, the researcher sought deeper clarity of responses to ensure that they were in line with the research objectives.

3.8.3 Dependability

Dependability is defined as the extent to which two independent researchers studying the same phenomenon can arrive at the same conclusion or the extent to which the same researcher can study the same phenomenon at a different timeframe can arrive at the same conclusion (Bhattacharjee, 2012). The research ensured that the research instrument can be reused, is consistent and dependable to ensure dependable and reliable results (Seale, 1999). Similar research conducted highlight some of the findings discusses in this research. An example is a study conducted by Kshetri (2017) titled “The economics of the Internet of Things in the Global South”.

3.8.4 Confirmability

Confirmability is defined as the extent to which the findings of the research can be independently confirmed by others (Bhattacharjee, 2012). The research data was analysed as collected and presented accurately to ensure confirmability (Shento, 2004). The findings of the research were presented at academic conferences to an audience of academics and business leaders. Feedback and critic on the research work was received and incorporated in the study. The list of published work is highlighted in this paper.

3.9 ETHICS AND ETHICAL CONSIDERATIONS

Saunders, et al. (2009, p.184) stated that “research ethics, therefore, relates to questions about how we formulate and clarify our research topic, design our research and gain access, collect data, process and store our data, analyse data and write up our research findings in a moral and responsible way. For this research, the following ethical considerations were ensured:

1. Permission to conduct the research was requested from the University’s Ethics Committee.
2. All respondents were sent a letter requesting them to be part of the research.
3. Permission to be interviewed was asked from the individuals before they were interviewed. In 2003, Gregory wrote that “Every code of ethics designed to guide research involving human subjects gives primacy to the requirement of fully informed voluntary consent on the part of the individuals concerned” (p. 35).
4. All individuals that participated in the research participated voluntarily and were not pressured (Ritchie, Lewis, Nicholls, & Ormston, 2013).
5. All information collected from the research was confidential and only used for the purposes of this research (Ritchie, et al., 2013).
6. All the participants were kept anonymous, no direct or personal information was requested from the respondents (Ritchie, et al., 2013).
7. All information gathered from the research was kept on the researchers’ personal computer which is protected by a password and backed up on the researcher cloud storage for safe keeping.
8. The researcher respected and ensured that the respondent’s right and privacy are not harmed (Saunders, et al., 2009).
9. Respondents were informed of the purposes of the research and how the data will be used (Saunders, et al., 2009).
10. All information gathered from this research is disclosed; either unexpected or negative (Bhattacharjee, 2012).

3.10 RESEARCH PLANNING

An empirical research can take a cross-sectional or a longitudinal time frame. A cross-sectional time frame is used to study a phenomenon at a particular time, while a longitudinal research study aims to study change and development over a long period of time (Saunders, et al., 2009). The research adopted a cross-sectional time frame as data will be collected at one point in time, analysed and findings and conclusions were presented from that data (Babbie, 2013).

3.11 SUMMARY OF CHAPTER

The purpose of this chapter was to outline the methodology that was followed to answer the research questions that were constructed to answer the main research problem and sub-problems identified in the Literature Review Section. The researcher took a subjective ontological view of reality taking an interpretivist stance to gather knowledge to explore the use and the potential use of IoT in South African retail businesses. The research further took a deductive approach to theory using the TOE Framework as a lens to guide the research using qualitative research methods to gather data. The research instrument used for this research consisted of semi-structured interviews. A total of 12 interviews were considered for this research. Table 1 shows the summary of the research methodology for this research.

Table 1: Summary of Research Methodology

Methodology	Approach
Ontology	Subjectivism
Epistemology	Interpretivism
Research Purpose	Exploratory
Approach to Theory	Deductive
Research Approach	Qualitative
Data Collection Method	Interviews
Research Instrument	Semi-structured Interviews
Population	South African Retail Businesses
Sample	Head of IT
Sampling Method	Purposive Sampling
Data Analysis and Interpretation	Thematic Analysis

4 RESEARCH FINDINGS, ANALYSIS AND DISCUSSION

The purpose of this chapter is to give a report on the findings by giving an analysis and discussions on the themes outlined in the Literature Review. The Literature Review was discussed in Chapter 2 and the Research Methodology was outlined in Chapter 3.

4.1 INTRODUCTION

The study used qualitative research methods to answer the main research question and sub-questions to accomplish the main research objective and sub research objectives. The main objective of this research was to explore the use and the potential use of the IoT in South African retail businesses. The sub research objectives were to determine the use and the potential use of IoT in South African retail businesses and to investigate the challenges and the potential challenges of using IoT.

The research questions used to gather data for this research were developed using the TOE Framework detailed in Chapter 3. The research took a deductive approach to theory, using subjective methods of data collection primarily using interviews to collect data. Qualitative research methods were used to analyse the data collected through thematic analysis using NVIVO as software to identify the themes.

4.2 DESCRIPTION OF SAMPLE DATA

The request to be interviewed was sent to approximately 50 individuals. Only 14 individuals responded and were willing to be interviewed for this research. Of the 14 respondents received, only 12 were considered for this research. Of the 2 respondents that were not considered, 1 was interviewed but did not send through their consent form authorising the use of that data for this research. The other respondent had not confirmed their availability to be interviewed by the time this report was gathered.

Table 2 gives a profile of the respondents that were considered for this research.

The potential use of the Internet of Things (IoT) in South African Retail Businesses

Table 2: Profile of respondents

Description of respondent	Industry	Interview Type
Environments Manager	General Merchandise	Face-to-Face
General Manager: IT (GM-IT)	Furniture	Skype
IT Solutions Executive	Pharmacy, health and beauty	Face-to-Face
Enterprise Architect Executive	Pharmacy, health and beauty	Face-to-Face
Regional IT Executive	General Merchandise	FaceTime
Head of IT: Central Applications	General Merchandise	Face-to-Face
IT Operations Analyst – Retail Systems	General Merchandise	Skype
IS Executive: Head of Architecture and Innovation	General Merchandise	Face-to-Face
Head of IT Infrastructure and Acquisition	General Merchandise	Face-to-Face
Chief Information Officer (CIO)	Fashion	Face-to-Face
Supply Chain Manager: Special Projects	Home Entertainment	Skype
Chief Information Officer (CIO)_2	Home Improvement	Face-to-Face

4.2.1 Sample Analysis

The respondents that participated in the research consented to the research in writing for Face-to-Face interviews or electronically in the case of an online interview, i.e. video interviews. The average duration of the interviews was 40 minutes. All respondents were from the IT departments within retail businesses in South Africa. The respondents needed to be in a managerial position to be considered. Demographics of the respondents, such as age, the number of years

in the organisation, gender, educational qualification among others were not considered for this research.

4.3 THE USE OF IOT IN RETAIL BUSINESSES

The IoT devices in retail businesses create new business models, improve productivity, reduce costs and increase sales (Manyika, et al., 2015).

The research questions used to explore the use of IoT in South African retail business were:

- What technologies will be used for IoT in South African retail businesses?
- What business processes will be enabled and affected by IoT in South African retail businesses?
- How will IoT be used in the South African retail environment?

The findings revealed that retail businesses are not specifically looking at certain technologies to use with IoT, but rather the aim is the end result and then considering what technologies will fit to make the process achievable. Respondents looked into RFID tags for tracking of goods and stock, however, they will wait for the implementation of the technology. Scanner, beacons and sensors were among other IoT devices that respondents are looking at using in their retail businesses. Moreover, the IoT could be a range of devices that can be used to achieve a common goal. This agreed with Atzori, et al. (2010) that there are many technologies that exist that enable IoT, and these technologies work together to offer IoT its capabilities.

Further, the core business processes that will be enabled by IoT include accurate fulfilment, automation, queue busting technology, self-check-out technologies and checking footfall in the stores as well as collecting customer data to make sales more efficient. The IoT is therefore set to automate business processes and make them easier (Bi, et al., 2014). Businesses that are using IoT are using the technology to run their complex operations and enabling their systems to make

⁴ Parts of this section was adapted from Literature Review submitted 25 July 2016

autonomous decisions based on the data and sensor reports delivered by these systems (Bughin, Chui, & Manyika, 2013).

The findings agree with the TOE framework. For a business to efficiently use IoT, the business Information Technology (IT) infrastructure will need to change to integrate different functions over different platforms (Bi, et al., 2014).

4.3.1 Technologies used for IoT

Q1: What technologies will be used for IoT in South African retail businesses?

The findings revealed that there are a variety of IoT technologies that South African retail businesses regard as IoT.

Head of IT: Central Applications stated that *“There are quite a few things that one could class as the IoT...”*

“...IoT could mean a whole range of things...” (Enterprise Architect Executive).

The findings agree with Balaji and Roy (2017), IoT is not a single technology, but different technologies that are connected to achieve a common goal or perform a dedicated function. Respondents further revealed that they do not look at specific technologies to use, but rather they seek the end goal and find enabling technologies to achieve that goal.

General Manager: IT (GM-IT) stated that they had seen an opportunity, in the future, there might be an opportunity like RFID in our big shops where currently it takes 2-3 days to do a stock take. IT Solutions Executive stated that they have taken a look at RFID and how to make a use of RFID in stores. *“we’ve done research into things like RFID tags and we’ve done pilots on RFID tags to track merchandise and to help us with stock count and so on”* (Head of IT: Central Applications). Alternatively, General Manager: IT (GM-IT) stated that *“we do not have any fancy RFID scanning”*. While Head of IT: Central Applications stated that they will wait before the implementation of RFID tags.

The above-mentioned concur with Atzori, et al. (2010) and Zancul, et al. (2016) that the key components that make up the IoT are RFID systems, which are made up of readers, which trigger transmission of signals and tags, and are equipped with unique identifiers in the objects, tags, sensors, and actuators.

Apart from RFIDs, retailers in South Africa are looking at using scanners, such as door scanners to manage security as well as video devices to achieve the same purpose in long distances.

Furthermore, Environments Manager said that *"We are looking at your door scanners, which helps to improve the theft and there's also future growth"*. General Manager: IT (GM-IT) stated that they use scanners everywhere.

Enterprise Architect Executive mentioned that their business uses devices and sensors to tag the products so people don't walk out the front door with it and that's the most basic use.

Further, retailers are looking at using beacon technology to measure the foot traffic in their stores. Beacon technology and sensors help retailer measure the aisles which customers commonly visit in their store and using that information for marketing purposes.

IT Solutions Executive stated that *"the first one is using beacons or beacon technology, that's the first stream which we looked at"*. Head of IT: Central Applications mentioned that *"...we've played with beacons in store to understand foot traffic. So, if you walk past a shelf and we know that you are a mother and you walk past the baby thing we might say oh go and get these nappies at the food market or something like that or give you a voucher. We have played with that but we haven't put money behind it to actually roll it out"*.

Hugo Boss stores have these sensors installed in their stores to map out the customer journey. This was stated by Gregory (2015), the retailer uses this information to place their premium products in the aisles with high traffic. Retail businesses in South Africa aim to have the same technology in their store to understand their customer journey.

Furthermore, results revealed that retailers in South Africa, especially in the clothing industry are looking at using magic mirrors and gesture controls to improve their in-store customer experience to eliminate the need for changing rooms in stores. However, retailers have largely done this as Proof of Concept (POC) and have not rolled it out to the public. Head of IT: Central Applications also stated *that “we have planned what you call the magic mirror, we haven’t chased that down. We’ve seen demos”*.

Velosa, et al. (2015) as well stated that most IoT technologies are not a complete set needed to build an IoT business solution, the technologies still need to be configured, modified and integrated with back-end systems and data to build an IoT solution best suited for their businesses. This concurs with Enterprise Architect Executive that *“you also need to have the backend integration software and you have to have the integration between the backend systems, your stock management systems, your warehouse management systems”*. Enterprise Architect Executive further argued that *“you will also require gateway technologies to access these specific IoT devices”*.

4.3.2 Business Processes enabled by IoT in retail

Q2: What business processes will be enabled and affected by IoT in South African retail businesses?

If businesses use or plan to use IoT they will have to plan for the reinvention of their business processes (Geschickter, et al. 2015). Market competition and new customer demands drive businesses to willing or unwilling change from their traditional business models to service based models and provide solutions that are both product and service based (Kindström, 2010).

Supply Chain Manager: Special Projects stated that there are 3 major business processes that are important. *“1. Is accurate fulfilment - that for us is enabled by technology and without it, we wouldn't be able to do that. 2. Automation of back-office functions like finance and reconciling payments and things like that so our warehouse is fully integrated with our finance system so when something leaves the warehouse it immediately goes off on our stock system which means it writes*

into our ledgers so at our scale we wouldn't be able to hold like monthly stock and stuff like that, so it wouldn't be viable so we have to work on an always connected system. 3. Customer expectation so if we don't have accurate information, you can't go on your app and track your order and see if it's going to be on time or not.”

Gregory (2015) and Tiwari and Dewangan (2015) stated that retail businesses can use IoT to optimise the process allowing for automated check-out processes where customers need not to stand in lines to pay for purchased goods, but they can be charged automatically when they walk out the store, reducing labour costs and cutting the time a customer spends in the store. This concurs with the findings that retailers in South Africa are looking at using self-check-out technologies that are enabled by IoT to cut down on the queues in the retail stores and also save on labour costs. However, retailers mentioned that they are not looking at stores that solely have self-check-out, but rather a combination of the traditional check-out and self-check-out as some of their customers might still require assistance when checking out their goods and also trust still remains an issue in new technologies.

“There'll be a lot of things which need to adjust if you are moving in that direction, but on the other hand, we need to realise that we'd probably only my guess 20 to 30% of our clientele going in. The other part of our clientele going in would probably have no interest of this, they'll be still happy in getting the products, go into a queue and then stand and have someone else scan it and put it in the basket for them so it wouldn't necessarily change the whole landscape, but I think these are things I would keen to sort of have in a concept store, you test all these technologies, you take the learning from there and then you roll out” (IT Solutions Executive).

For businesses to fully harness IoT, they will need to move from their traditional business processes and adapt to new business models that will fully incorporate IoT and then the business will start seeing the value proposition of IoT (Bughin, Chui, & Manyika, 2013). Retailers are looking at using IoT devices to understand their customers in-store to enable a direct engagement with their customers. This agrees with Gregory (2015) that businesses are using IoT to improve their customer experience creating a new paradigm of “Internet of Me”.

IS Executive: Head of Architecture and Innovation revealed that *“in future if you look at the context of IoT for a person in the store and what it means for our customer there are a whole of direct engagement that we could drive for our customer's in terms of our in-store experience and we know those are kind of coming out in terms of use cases.”*

Chief Information Officer (CIO) also revealed that their business is potentially looking at having systems in place that will detect customers when they walk into the store. *“We plan to implement it this year as POC. and it will pick up that it's Nomusa and we have all the details on Nomusa on the customer database and we will see that Nomusa was looking for something online last night, a jacket and it was a medium size and they will look at the stock in a store and say they is a medium and they will look at the vouchers and say Nomusa has 20% off a jacket and straight away come back and say Nomusa I hope you have a good shopping day and by the way, the jacket you were looking for is in the store, in your size and you have a voucher to encourage the sale and then they will say yes please and hit a button and goes to a sales associate and goes to finds it and finds Nomusa in the store. That's an enhanced service that we are trying now”.*

Similarly, IT Solutions Executive mentioned that their business is taking in the full online journey, but just within the store so it's all about the triangulation, understanding where customers are, understanding what's walk time within this section and within this area. Because that then begins to give you information which you know is usable for up selling and everything else. *“If we know that you've stood in front of this particular good and you walked away, you came back and you walked away, when you come back, if we can target you, it basically showing that you wanted something there”.*

Retailers in South Africa are also looking at creating self-sufficient customers in the store, where customers can use the IoT devices embedded in their stores to gather information on the products in store creating more efficiencies in store.

“If you can imagine walking up to a shelf and the shelf is empty and you just scan the barcode and it automatically tells you we do have 2 in the stockroom. There's

one in transit, and by the way, if you don't find this at our store, 5 or 6ks away we have it in stock, totally different, you are changing the conversation, but that's stuff which IoT allows you to do” (IT Solutions Executive).

“The purpose is really about gaining efficiencies. So, if you know exactly where your stock is and you know the movement of your stock. You can plan that movement much more efficiently and as a consequence, you can also keep less stock. So, in retail, you got to keep as little stock as possible, but you still need to make sure that you meet your demand for the stock and that is a very delicate balance” (Enterprise Architect Executive).

However, IS Executive: Head of Architecture and Innovation argued that *“we don't see IoT at our current landscape enabling any business processes that we don't currently execute, all that we are doing is currently enabling the more efficient execution of those business processes. Take for example power consumption, we are monitoring power consumption in each of our stores in isolation the benefit that we have of moving to a more centralised publication of IoT type currently governing a utilisation basis what the power consumption is between similar stores”*. General Manager: IT (GM-IT) opposed by arguing that are many opportunities and they are obviously many many more.

Q3: How will IoT be used in the South African retail environment?

An IoT driven business transforms the physical business processes into efficient digital processes, as IoT enables businesses to digitise, sell and deliver physical assets more virtually (Brody & Pureswaran, 2015). The IoT can be used to improve business process efficiencies, reduce the cost of warehouse logistics as well as in service industries (Murray, Papa, Cuzzo, & Russo, 2016). This agrees with the findings of the research. Retailers in the South African environment see a great potential in its use to enable automation and efficiencies in the supply chain enabling possibilities that were only imaginable a few years ago. These include using robots as a picker in their distribution centres eliminating the need for human picker creating an efficient and faster process. However, retailers in South Africa do not have the right capacity to perform these tasks which still remain a possibility rather than a reality.

Environments Manager stated that *“there’s a lot of general uses throughout SA and this is not just in the big retailer, even your smaller retailers, it's opening up the huge gap”*.

IS Executive: Head of Architecture and Innovation revealed that *“we can see, some context in the SA retail market we tend to lag behind the European and American markets by a number of years. So, what a lot of our technology roadmap is essentially looking at what's happening in those markets and try and cherry pick those activities as to what will apply in the SA market. And you have varying degrees of success so you can argue that the loyalty program is very successful in the European, but in the SA market it hasn't been as successful”*.

4.4 THE BENEFITS OF USING IOT IN RETAIL BUSINESSES

The undeniable and basic benefit of using IoT is its ability to impact and potentially change the everyday processes of its use (Atzori, et al., 2010). The findings revealed that benefits of using IoT include automation, efficiencies, availability of information and personalisation of customer requirements.

The research questions used to explore the potential benefits of using IoT in South African retail business were:

- What technological benefits will IoT have in South African retail businesses?
- What organisational benefits will IoT have in South African retail businesses?
- How will IoT benefit the South African retail environment?

Q4: What technological benefits will IoT have in South African retail businesses?

4.4.1 Automation

The findings revealed that retailers are looking at using the IoT to automate business processes to accelerate growth within their businesses. Automation of processes in the retail environment will increase efficiencies for retailers and also give the retailers an ability to be agile in their decision making. Furthermore, automation using the IoT will enable retail businesses in South Africa to be easily scalable because as they grow, they will not require more people to perform a task, but rather tasks will be easily performed by enabling the IoT devices.

“Businesses are happy to grow at 5, 7, 10 % a year; we typically grow to between 15 to 100% in a year. And that places a limit because there is no way we can keep on hiring and doubling our workforce every second year wouldn't necessarily work, there are so many people that you can fit into a warehouse. For us to get to scale

where we need to be, we have to automate in order to drive efficiencies” (Chief Information Officer (CIO)).

Automation in business processes will enable retail businesses to keep the right amount of stock and avoid overstocking or understocking of goods in the distribution centres. This will be made possible through the use of sensors that will be able to monitor the stock levels and send information to the retail autonomously.

Enterprise Architect Executive stated that *“If you had these sensors as delicate in your equipment, you will be able to automate the update of your inventory of all your systems and that means you will be able to better understand and manage where your stock movement is happening and as a result you will be able to move more efficiently, you will be able to keep just the right amount of stock. That means you can reduce your stock holding. In the retail sector, your business model rests firstly on your sales, but also, it's balanced against the amount of stock you keep in the backend. So, you don't want to keep a thousand toasters if you really should be selling 500 means you can only reduce by 500 and not keep your money invested in toasters that are sitting in some warehouse and not earning you money”.*

Furthermore, automation will also allow retail businesses to diagnose problems within their processes with a faster turnaround time enabling the business to make decisions to fix the problems quick decreasing downtime and reducing costs and waste in downtime.

“You don't have to pick up the telephone to speak to a person to ask what's wrong. You can literally by the click of a button see the whole structure and where something fell apart. So even pinpointing a fault once again a reduction of turnaround time, no waste. Where previously a goal or Service Level Agreement (SLA) be 4 days, for example, to correct a fault in a retail store. A head office can now pinpoint the fault within minutes and immediately send someone out from the closest dispatch theatre. So now your turnaround has come down from 4 days to 4 hours” (Environments Manager).

“The first gap is there's a lot of stuff we don't know within the process of our business, so the wave of IoT will help us to give us intelligence to close the gap. So, unless there's an understanding on how we can improve our business that's when we will look at technology to automate the processes” (Head of IT Infrastructure and Acquisition).

Automation will lead to businesses achieving scale as retailers will be able to speed up processes avoiding waste and cost. Moreover, the use of IoT will enable businesses to be in sync with what is happening in the business in real time.

“So, the main idea is to use IoT to simplify, speed up processes, get more people in and out of the store, in and out of the general retail train without causing them the unnecessary time wastage or clutter... the core benefits in this stage would be a reduction in processing time” (Environments Manager).

Retailers see benefits in areas such as quick response to problems, trend analysis, cut down on waste, efficiency, creating smart and self-aware products to create a cognitive environment.

4.4.2 Information

The availability of information as one of the major benefits of using IoT. Retail businesses will be able to receive information quicker when using the IoT and therefore, able to make quick and informed decision to get a competitive advantage when compared to other retail businesses in the same market. Retail businesses are currently facing a challenge as they receive information late and therefore have a longer reaction time and therefore limiting the actions that they could take with the information should it had been received in real time. Therefore, IoT offers retailers the ability to have reacted quicker to opportunity or threats in their environment.

“The generic benefit across every business is the availability of information. So, what this is enabling us to do is to really ramp up our communication as well” (General Manager: IT (GM-IT)).

Regional IT Executive stated that *“I do see that will simplify the business. It will get information quicker and you can react quicker. Whereas at the moment we have a long reaction time and as soon as you can react quicker you can get the stocks to the stores. It will also help bringing down your stock levels because you do not have to keep a lot of stocks”*

“So, the ability to have product offering available and visible to customers is very powerful. That will be extended into the future to have quite a lot of information on the products like features and benefits and everything else” (Chief Information Officer (CIO)).

“From the distribution centre perspective, it has helped us a lot to reduce cost and you have things like shrinkage, theft and human error all those things would have been reduced because we have systems in place that can actually do things that used to be done by a person, but now those systems are in place and they can do those things in an efficient and effective manner with minimum errors and distractions. If you service machines them correctly it's a no brainer, no strikes. The business will continue to run” (IT Operations Analyst – Retail Systems).

Information can be a benefit, but the real value comes in when the retailers are able to turn that information received into meaningful information to help in the business. This then links to the need of Big Data Technologists and Business Intelligence Analyst to make the decision-making process easier in the information age as IoT technologies will create a lot of information, but the true benefit and value come and from making turning this into meaningful information.

“Also, have the right analytical tools to analyse and respond to the information that's being created so there's a lot of benefits with IoT” (Head of IT Infrastructure and Acquisition).

“All the information is what we need to make the decisions with to update stock on hand or the entire value chain and then, but that information is only valuable when it's mine when it's analysed. So as the technology is easy to put in place and the value that comes. But you need to have those financial building blocks in place to empower the business and a data scientist to actually change the data into information and react on that because if you don't, you'll miss an opportunity it actually provides” (Head of IT Infrastructure and Acquisition).

Q5: What organisational benefits will IoT have in South African retail businesses?

Organisational benefits include the availability of information, efficiency and personalisation of customer requirements. Retailers are seeing organisational benefits in information received from IoT for organisation benefits and are able to gather information about customers while they are in store to enable efficiency and personalisation of customer requirements.

“Customer movement in our stores, how long they stand in front of a promotional item and whether the promotional items are well positioned in terms of the footfall and the customer journey in our stores” (Head of IT Infrastructure and Acquisition).

“We have also run out a pilot for salespeople to have product knowledge, how the products are selling. The good products, the bad products and all the customer information” (General Manager: IT (GM-IT)).

Efficiency remains one of the basic benefits of IoT in retail businesses. IoT offers retail organisations the ability to automate for decision making in the organisation for faster repairs, faster turnaround time, faster implementation and information at your fingertips which generate profit for the business and enabling control in the business.

“Organisational benefits are really about the efficiency and the ability to automate. It about the ability to have real time decision making and automate the decision making” (Enterprise Architect Executive).

“So once again, faster repairs, faster turnaround time, faster implementation and information at your fingertips. Just enables the retailers of SA to bring to the client even better service. And of course, all of that turns out into profit” (Environments Manager).

4.4.3 Personalisation of Customer Requirements

The IoT will enable the personalisation of customer requirements in the stores. Retail businesses will be able to gather unique information about their customers and therefore selling products that are unique to the customer and resulting in the increase in sales as the business will have an informed perspective on their customer requirements.

“Personalisation of customer requirements would be very strong. To tailor what the customer wants. We would like to tailor what we offer customers to what the customer would like, again looking at fulfilling the aspirations again on a very personal level rather than generic. It would mean to us in the long run to create a personalisation of our interaction with the customer. But I think businesses of the future will be businesses that deliver what the customer's want because customers will be bombarded by people trying to do things over the internet. Our likely approach is to have a personal relationship with the customer” (IT Solutions Executive).

“For X, improving the quality of the product and therefore, improving our customer experience. Improving our customer experience is one of the biggest benefits, it could be through improving quality, but also understanding customer behaviour. So, positioning things better in the store to make it more convenient. So, if you analyse the route that people take through the store, you could optimise that. So, you could the products around so people don't go in, up and back, it means they are not finding what they are looking for. Generally, I think there are a lot of opportunities that will

help us improve customer experience either through that product or through that experience. We are conscious that online shopping is something of the future. We have seen that the online shopping in Australia is bigger than it is here, there's a lot of investment into that" (Head of IT: Central Applications).

Q6: How will IoT benefit the South African retail environment?

The benefits of IoT in the South African retail environment include efficiencies in the supply chain and collaboration within the ecosystem. The IoT will enable collaboration between suppliers as well as centralisation between businesses departments that exist in different parts of the country and the world.

IT Solutions Executive mentioned that *"If you take what I've said about efficiencies and automation. The retail environment is already an environment where in order for X to operate, we rely on an ecosystem of other companies, not talking about vendors who supply goods and trucking companies who move our goods around SA"*.

"Across retail businesses, I would have to say that the benefit as mentioned earlier would be supply and demand. So, the benefit will come where it allows more multiple businesses to coexist. To be able to supply each other with bigger variety at competitive prices. Instead of using only one supplier you can now use five suppliers. Be it a local supplier or someone growing or providing something from Muizenberg or Johannesburg. Either way by implementing, you open up doors. You immediately now allowed to cross-communicate and drive businesses over a long-distance or short distance and previously where you not have known that business or supplier existed. Everything has just become more productive and connected. So, the whole of SA the more IoT gets implemented. So, everybody has got a chance and a fair chance at that to start their own business to become an entrepreneur" (Environments Manager).

4.5 THE CHALLENGES OF USING IOT IN RETAIL BUSINESSES

Technology, like IoT, undeniably benefits businesses in various ways; however, it also presents challenges to businesses (Zimmer, 2008; Geschickter, et al. 2015). For businesses to fully reap the benefits of IoT, they will need to overcome its challenges and more as the number of connected things is escalating with each passing year (Coetzee & Eksteen, 2011; Dijkman, et al., 2015).

The research questions used to explore the potential challenges of using IoT in South African retail business were:

- What technological challenges will IoT pose in South African retail businesses?
- What organisational challenges will IoT pose in South African retail businesses?
- What challenges will the South African retail environment have when using IoT?

The questions focused on the Technological, Organisational and Environmental challenges.

Q7: What technological challenges will IoT pose in South African retail businesses?

4.5.1 Cost challenges

Cost is the biggest technological challenge. Due to the unpopularity of IoT devices in South Africa, this has greatly contributed to the high prices of these devices as well as the high 3G/4G costs in South Africa as compared to other countries. Retail businesses have since ventured into having free Wi-Fi in their stores to encourage their customer to use their services.

Regional IT Executive stated that “the other thing will be the cost of 3G, the reason we are putting Wi-Fi in is we trying to keep the cost down”.

“Then you look at the cost and what it will do to your prices compared to your competitors” (General Manager: IT (GM-IT)).

Furthermore, another challenge is getting IoT to make the business money. The IoT is seen to bring in more cost than bringing in profit for the business. The respondents believed that IoT was a “fancy” way of providing efficiencies that can be performed at a lower cost and until IoT can bring in money, the cost of it will remain a challenge.

Supply Chain Manager: Special Projects revealed that *“nothing in business can run if you don't have the capital for it and it does also limit you. For instance, if you look at mobile scanners, mobile devices, barcode scanners, all of those things cost a fair amount of money. Stuff is expensive and that has an impact on how quickly you can innovate, how quickly you can add technology and all of those things”.*

Due to the low number of locally produced or sold IoT devices, retail businesses find it very costly to import these devices thus limiting the uptake on IoT in retail businesses.

Environments Manager revealed that *“the problem is still costing of it because there are not enough local retailers or providers of self-services, so most of the services are still brought in from overseas. Unfortunately, you can't with the conversion rate and currency does have a crippling effect”.*

4.5.2 Devices

Latest technology is often times compatible with the similar latest technology. The challenge is having this technology compatible with the customers' devices. If the customers do not have devices that are compatible with the in-store IoT devices, this defeats the purpose of having these devices in store as the customers cannot use them. Therefore, the challenge is ensuring that the IoT devices in store are compatible with the devices that customers bring in.

“People have this view that everyone has a smartphone, which is not true. You will have to cater for those that smartphones and those that do not have smartphones.

You will have to cater for a world where people have simple technology vs complex technology” (General Manager: IT (GM-IT)). “I like to mention as well is sort of your consumer base because you can have the fanciest contactless payment methods that you can think of, but if your consumer walks in store with a Nokia then it's not going to work. You also have to take into consideration the adoption level of consumers in the market” (Head of IT: Central Applications). General Manager: IT (GM-IT) stated that “our increasing focus is making systems easy to use. The modern approach to development is to develop the applications for people, it is not to make people's lives complicated.”

4.5.3 Security challenges

Security challenges posed by using IoT remain one of the utmost challenges to businesses (Tully, 2016). Retailers are finding security in the IoT as a challenge. There will be a high number of devices in the market and the challenge will be selecting the right and secure devices. Retailers raised concerns on if devices are secure enough to independently run business processes without being tampered with. Roman, et al. (2013) argued that the security of IoT technologies is seen as a complex task because there is a connection of billions of devices and as more devices are connecting, there is an increase in the potential attacks of IoT technologies.

“The challenges will definitely be around security and the right devices that will help us” (Head of IT Infrastructure and Acquisition).

“So, I foresee the market being flooded with various devices that are IoT enabled. There will a challenge for the CIO to select the right device that is secure, that's robust and fit for the environment so if we very much cost focus we might go for inferior devices, but might compromise security or stability” (Head of IT Infrastructure and Acquisition).

IT Operations Analyst – Retail Systems stated that *“it might be an issue and also security, is it secure enough? If I secure transactions like you scanning items and the customer has to pay for them is it secure enough? Can it not be tampered with?”*

And there are no fraudulent transactions that can take place and things like that, the cost and also, we are in the business of people and people sometimes appreciate people interaction instead of dealing with a machine.”

“The biggest challenge in our economy, SA, will be to enable this, to give the right secure device. Otherwise, that take up will be very much slow taker similar to moving to cloud in terms of security” (Head of IT Infrastructure and Acquisition). Head of IT Infrastructure and Acquisition further revealed that *“...In the SA context, ...for instance security, those considerations are slowing it down to really adopt the fullness of IoT. So, you will see these footprints of IoT in very developed businesses, but really growing it to a full-on integrated into our business processes will take a long time”*.

4.5.4 Privacy challenges

The IoT technologies receive and send large amounts of data between devices and therefore are prone to a high-risk when it comes to the privacy of data (Weber, 2015). There is a concern about the privacy of data that is produced by the IoT. Data privacy remains one of the major challenges of IoT, the data that is used by different connecting devices creates trust and privacy issues (Trequattrini, Shams, Lardo, & Lombardi, 2016).

IT Solutions Executive stated that *“Privacy discussion comes in if we start selling that information to someone else, but we would explicit in terms and conditions”*.

4.5.5 Network challenges

The increase in the use of IoT technologies poses capacity and bandwidth challenges causing failures in the networks (Newe, 2015). Current traditional networks do not provide technical features and operational cost for IoT devices that require wide-area coverage and low bandwidth, good battery life, low hardware and operating costs, and high connection density (Jones, 2016).

“When it comes to bandwidth and connectivity it is a challenge in SA. In terms of the industry, you going to deal with connectivity issues” (Enterprise Architect Executive). Regional IT Executive further stated that *“...a lot of Africa countries, we always have downtime,” “...also having enough bandwidth to collect the information and from a backup storage to have the storage not only to store the information”* (Head of IT Infrastructure and Acquisition).

“The biggest problem with technology changes is infrastructure in SA and unfortunately SA is still a little bit behind and at the moment we are being supplied with infrastructure, but it’s a very very true struggle to try and get it for example. If you want to go optical fibre that allows you high enough bandwidth to be able to transfer big bulks of information between retail chain and head office even for a support engineer to log in. Anything which requires, fast connection, there are systems are upgraded and there are processes. The bulk load is getting so much more, unfortunately, the infrastructure of SA, Telkom for example, is not coming up fast enough. And now you have got the option fibre only some places benefit, some people benefit and if they wanted they can do it right now. But it is at a ridiculous ridiculous price. You can choose to either go and buy it myself or do I have Telkom activate it for me. The biggest challenge is literally our infrastructure” (Environments Manager).

4.5.6 Governance challenges

The use of IoT technologies in businesses elevates governance challenges. This could be infrastructure governance or general regulations (Trequattrini, et al., 2016). The IoT technologies need to ensure interoperability, the right of access, the robustness of the infrastructure and reliability of the devices. Notably, governance Legislation pose limits on the use of IoT and a single legislation cannot yet be developed to govern its use (Weber, 2013).

The findings agree with Trequattrini, et al. (2016) and Weber (2013). Retailers find governance of the IoT a technological challenge. This emanates from the wide variety of available devices in the IoT. This was found to be a challenge, not only in the context of South Africa but globally.

“In terms of standard, I think that's more of an international issue and then of course what I said earlier when I was talking about the technologies, the availability of standardised gateway to enable the integration is probably a technological challenge” (Enterprise Architect Executive).

Q8: What organisational challenges will IoT pose in South African retail businesses?

Retailers find change management as a major organisational challenge when introducing a new technology as the IoT. The challenge of job change within the retail space and shareholder buy-in. The IoT is set to change how retailers and individuals perform tasks. The change will largely impact on how people do their jobs. Employees fear that the IoT will cut down on the number of jobs available because of automation. However, retailers see this as a transformation in the job structure, creating new jobs and opening up new opportunities. However, the challenge is effectively communicating this to employees that have been performing the same tasks for many years. Retailers foresee change as a challenge and getting the employees to embrace the technology.

4.5.7 Change Management Challenges

Chief Information Officer (CIO)₂ stated that IoT is *“just a transformation from one job to another job, people will always be needed until a certain point in time where automation advances, but anyway automation is the future”*. Chief Information Officer (CIO)₂ further stated that *“in terms of losing jobs, people need to understand that if tomorrow you bring Amazon Go in SA all those cashiers who seem to lose their jobs, their jobs will be recreated on the other side so here it's a physical job in a physical shop”*.

“IoT is more likely to change people's jobs than it is likely to replace people's jobs. The times when we got rid of people are the times when we don't have enough money because there's not enough money we have to reorganise, so sales are down tough trading, we have to cut back” (Head of IT: Central Applications).

“Technology can only grow if you have human growing in the right direction” (Environments Manager). *“Change management is the biggest issue when you take on anything. Without proper change management, nothing will ever succeed”* (IT Solutions Executive).

Q9: What challenges will the South African retail environment have when using IoT?

4.5.8 Skills Challenges

A challenge to the use of IoT in South Africa is the lack of skills to use and manage the IoT devices. Respondents stated that institutions are not training graduates how to use and manage these devices, leaving the training to the businesses that hire graduates to train them and this is a challenge to the business. The South African environment currently has a shortage of IT or ICT professionals and this is a challenge to business when they plan to innovate as they do not have the right people to drive the innovation, implement it and manage it. This leads to limitations to innovation in the South African environment.

IT Operations Analyst – Retail Systems stated that *“And skilled people, how do you skill them? Do you have enough institutions that can train those people to support those systems or those technologies that you introduce to the business because as we speak now, we are in terms of the IT and ICT space in terms of skills there is a shortage although we have businesses and other institutions that are providing us, when you look and find the technologies that are out there in the business space, you take some time to train someone who comes directly from university to support a back of system used by X. You have to train them to learn the business and things like that and that's a challenge in that aspect”*.

“The challenge for people to sort of wrap their minds around is that the world is changing and we need to think differently so right now everyone is talking about drones. Lots of people are looking at ‘how do I design these drones?’ ‘how do I make this?’ Very few people are thinking ‘how do I set myself up to repair drones?’

Totally different look, we have all these drones coming I want to be set up and ready as an expect so when they arrive and any drone breaking they already know that X has got his drone fix. And they already know me, and that way you create employment and jobs and other things. While some jobs may shift, we have the opportunity to create other jobs and that is the key thing. The broader challenge would be, do we have the right skill base to play with a technology world. That's a broader challenge which we can't solve. This requires government policy and sorting out education. That could be a bigger challenge for SA, that are we there - yes or no? Do we have the right skillset to those things? You have to positive with technology” (IT Solutions Executive).

4.6 SUMMARY OF FINDINGS

In summary, the findings revealed that the use of IoT in South African retail businesses is still in the infancy stage. Retailers are still waiting to invest in IoT until they see its success in the retail environment.

“SA it's more of a target than a reality” (Chief Information Officer (CIO)_2).

“There’s a lot of work involved to get it running. But we not going to go there for a while” (General Manager: IT (GM-IT)).

Retailers are not prepared to spend large amounts of money on the IoT as it has not proven to be successful in the South African retail environment. Retailers are putting money into POCs for IoT, and with that, they are not willing to spend a lot of money just to play with the devices to see if they fit into their businesses. Retailers mentioned that they rather invest in other business structures rather than the IoT as it is currently not a priority in their business.

“IoT is expensive and partly why X is waiting, we rather wait until the cost of the technology comes down before going to invest in it” (Enterprise Architect Executive).

Nonetheless, retailers in South Africa still see the benefits in the use of IoT. These include, but is not limited to efficiencies, availability of information, personalisation of customer requirements, etc. These benefits will result in an increase in sales, achieving scale and gaining a competitive advantage.

“I think with every new technology there's going to be an element of concern around what that new technology means, but with every new technology, we got to be mindful of the impact of this” (IS Executive: Head of Architecture and Innovation).

Furthermore, the availability of skills is still another major challenge in the use of IoT in South African retail businesses. Retailers are concerned that South Africa is not skilled enough to manage these technologies and that tertiary institutions are not equipping students to be on par with the technology demands.

“Those are the challenges I foresee and also in terms of skills in supporting it if it breaks and if there is something wrong happens with the machine; do we have enough schooled people to get it up and running in the fastest time possible” (IT Operations Analyst – Retail Systems).

The South African environment is slowly becoming digital and businesses are opening up to possibilities of technologies such as the IoT. In the next 3-5 years' retail business, will start to use IoT for business processes because then the South African environment would have a better infrastructure to support the proliferation of devices. Currently, the debate is around the availability of bandwidth, the cost of the internet and the availability of a reliable power supply.

“SA is getting there, we have moved from analogue to digital to new technologies like ADSL and now they are actually introducing fibre and also with those technologies that are being introduced I think we can be ready given time. I am not sure how long, but I can say in 3 - 5 years' time. We have a monopoly like Telkom sometimes their service offerings are poor because they know that they are controlling the market and the other guys competing in their space battle with competing. But we are getting there, we are not there yet, but we are getting there” as attributed by IT Operations Analyst – Retail Systems.

“...retail is unique in many ways, but one way in which retail is culturally unique to others. Is that if it doesn't sell more product they will not invest money in it. When you look at the IoT the challenge that we face is convincing current retail leader that it's not about selling more product, it's about being able to get efficiency improvement benefits and automation and the benefits that real-time decision-making gives them, which means they can respond in real time to changes in the industry and in the consumer behaviour and that means that instead e.g. keeping lots of stock, you can keep just the right amount of stock and you can move it at just the right time rather than moving huge volumes at regular intervals, you can move just the right amount at the right time” (IT Solutions Executive).

“SA as a whole, if we carry in the route that we are carrying very soon we should be on par with at least Americas retail industry and from there it's just a small jump to a global scale. Telkom and Eskom are our most crippling factors” (Environments Manager).

The consensus remains that IoT is set to offer the South African retail environment endless possibilities and retailers need to be ready to harness this opportunity to stay on edge in the current digital climate.

“The limits are your imagination” (General Manager: IT (GM-IT)).

“Yes, I can see that IoT type devices are creeping their way into SA businesses, but they are not doing it because someone told them the time is ready for IoT. They did it because for that individual project it made sense to do it. Is the time right for IoT? I have no idea because IoT can be 10000 different things, but should SA companies be considering individual projects that have IoT in them - Yes definitely” (Supply Chain Manager: Special Projects).

5 CONCLUSION

The purpose of this chapter is to present the conclusion to the study. Chapter 2 presented the Literature Review, Chapter 3 presented the Research Methodology and Chapter 4 presented the Research Findings. This chapter is structured as follows: 5.1 Summary, followed by; 5.2 Discussion of what can be learned from this research and Finally; 5.3 Recommendations, both for further research and practice.

5.1 SUMMARY

This section summarises the research: what the research question was and what are results.

The purpose of this research was to explore the potential use of the Internet of Things (IoT) in South African retail businesses. The objectives of the research were to:

1. To explore the potential use of IoT in South African retail businesses?
2. To explore how the South African retail environment can potentially use IoT?
3. To explore the potential benefits of using IoT in South African retail businesses?
4. To explore the potential challenges of using IoT in South African retail businesses?

The above objectives aimed to answer the main research questions below:

Research Question 1:

What is the potential use of IoT in South African retail businesses?

Research Question 2:

How can the South African retail environment potentially use IoT?

Research Question 3⁵

What are the potential benefits of using IoT in South African retail businesses?

Research Question 4

What are the potential challenges of using IoT in South African retail businesses?

The IoT is commonly defined as the interconnectedness of things and devices through a path or a network. The IoT is considered as one of the major advancements of technology in history and set to power a billion devices. The IoT is expected to create new opportunities for its users offering new applications and services.

In business, the IoT is expected to provide efficiencies and financial returns. The IoT technologies have changed the business environment, creating new opportunities for businesses; new ideas, products and services to meet the new demands of customers. Retailers are leveraging this new technology paradigm. Retail businesses are using the IoT to enable automated check-outs, smart shelves that detect stock levels, ability to guide customers in store to easily find products, real-time pricing and sale adverts, to gather information on customer buying habit to offer continued sales. The IoT is providing retail businesses with immense opportunities. The IoT provides retailers with the ability to offer an in- and out- of store experience for their customer by combining various different technologies that interact with each other.

Retail businesses are finding customer relationship management an important part of their business operations to understand customer behaviour, in store and out of the store in order to provide better services, improve customer experience, increase sales and profit. By the year 2020, it is expected that the IoT will change business processes offering to the interconnectedness of devices and things. Businesses that use the IoT are expected to gain a competitiveness in their market when

⁵ Parts of this section was adapted from Research Design and Literature Review

compared to other businesses in the same market that are not using IoT. However, for businesses to fully reap the benefit of the IoT and gain a competitive advantage they will have to be willing to change their business structure to incorporate the IoT.

Devices and things in the IoT have enabled various business processes in the IoT such as automated check-out which will potentially cut the number of needed cashiers by 75% resulting in profit between \$150 billion to \$380 billion a year in the year 2025. The IoT is expected to change the retail environment significantly. About 33% of South African businesses are expected to invest in the IoT in the next three years offering to the opportunities it presents. The IDC of South Africa stated that businesses will have to rethink their business processes to fully benefit from the use of the IoT.

The research was aimed to explore the potential use of the IoT in South African retail businesses and provide insight and guidance to CIOs, CTOs and Heads of IT in the retail business on the subject. The research took a subject ontological stance with an interpretive view of reality through a deductive approach to theory using the TOE Framework as a lens for the research.

The TOE Framework has been used in the field of IT to study a range of technologies. The Framework assumes three underlying paradigms that determine the adoption and implementation of innovations; these are the Technological context, Organisational context, and the Environmental context. Firstly, the Technological contexts refer to all the external and internal technologies available to the business. For this research, the technological context was the IoT. Secondly, the Organisational context refers to the characteristics of the business such as scope, size, trust, managerial structure, technologies readiness, the quality of human resources and a number of slack resources available in the business. For this research, the organisational context was retail businesses in South Africa. Lastly, Environmental context refers to the market in which the business operates which includes the industry, competitors, access to resources and dealings with the government. For this research, the Environmental context was the South African context. These paradigms interplay for an organisation to make a technological innovation decision.

The research took a qualitative research approach which is primarily informed by non-numerical data. The research used semi-structured interviews to gain an in-depth understanding of the subject to be able to uncover new ideas and themes. The research interviewed 12 individuals in IT managerial positions in retail businesses. All individuals interviewed participated in the research voluntarily and consented to the research. All data was kept private and confidential.

The data collected was analysed using Thematic Analysis which followed Braun and Clarke (2006) six steps of conducting Thematic Analysis. These are i. Familiarise or immerse in data, ii. coding the data, iii. identify themes, iv. review themes, define and v. name themes and vi. finally, write up.

The findings of the research revealed that retail businesses in South Africa are not specifically looking directly in the use of IoT, but rather they plan to create new business processes and the IoT comes in as an enabler. The findings further revealed that RFID tags remain the most widely used IoT devices. Whilst, RFID is widely used for tracking of goods and stock. This is followed by scanners, beacons and actuators. However, there is a wide variety of devices that retailers are looking at using which can be used to achieve a common goal.

The IoT is not a single technology, but a range of devices are aimed to enable core business processes such as accurate fulfilment, automation, queue busting technology, self-check-out technologies and checking footfall in the stores and collecting customer data creating more efficient sales. Therefore, retailers see the IoT as an opportunity. It suffices to say that, the IoT is not a complete solution, the technologies still need to be configured, modified and integrated with the businesses systems to get a solution that is best suited for the business.

Retailers are potentially looking at using the IoT to create self-sufficient customers and to create more efficiencies for the customer and the business. The IoT also aims to transform the physical business processes into efficient digital processes whilst enabling the business to digitise, sell and deliver physical assets more virtually. South African retailers see great potential in the use of the IoT in this

regard. However, due to the low availability of the IoT devices and right capacity to perform tasks, the IoT remains a potential for South African retail.

Even so, retailers have realised the potential benefits of the IoT, these include but are not limited to automation, efficiencies and effectiveness, availability of information, personalisation of customer requirements, etc. The IoT will potentially enable better communication between suppliers and retailers in the South African market, creating more efficiencies in the environment.

It is worth mentioning that there are potential challenges that come with the use of IoT irrespective of the numerous benefits. Firstly, the cost is the major potential challenges retailer will have with the use of the IoT. This is due to the low availability of devices and things that enable the IoT in South Africa. Secondly, the devices themselves are a potential challenge. The wider population of the retail customers might not have devices that could effectively interact with the in-store technology, irrespective to the technological advancement.

Thirdly, security and privacy also emerged as potential challenges. This widely stems with regard to security from the wide variation of connecting devices and a challenge arises when it comes to how to ensure that each device is properly secured. Fourthly, with regards to privacy, the challenge would be the amount of data that these devices and things in the IoT collect. To sum, there are a variety of potential challenges, change management within the retail businesses, the network infrastructure in South Africa, and availability of skills to support the IoT.

Regardless of the aforementioned potential challenges of the IoT, retailers are waiting on investing in the use of the IoT as it is still in the infancy stage in South Africa, therefore retailers are waiting to see the success of the IoT before investment. Notably, the findings further revealed that the benefits of the IoT outweigh its challenges. The IoT is set to offer the South African retail environment with endless possibilities, South African retailers need to ensure that they are ready to harness these opportunities when they boom to stay on a competitive edge and remain profitable.

5.2 DISCUSSION

This section discusses what lessons can be learned from this research.

5.2.1 Methodological Reflection

The methodological reflection discusses the extent to which the research approach influenced the results.

The research took a subjective ontological stance using an interpretive epistemological stance. The research took a subjective ontological stance to gain knowledge and in-depth understanding through interacting with the participants. The ontological stance informs the epistemological stance. The research took an interpretive stance. An interpretivist interacts with participants to gather knowledge through interacting with the participants and making sense of their world and goals.

The purpose of the research was to explore the potential use of the IoT in South African retail businesses this assuming an exploratory approach to theory. Exploratory research seeks to study a new problem or phenomenon, the approach to the phenomenon and its dynamics in order to give a report and identify further research. The process of theory development was deductive. The research used the TOE framework as a lens to study the potential use of the IoT in South African retail businesses.

5.2.2 Substantive Reflection

The substantive reflection compares the results of this research with other research on the same topic or area.

The research reviewed a wide range of literature for the study. The majority of literature found on the use of the IoT was not based in South Africa. Therefore, the study aimed to fill this gap. Literature found on the IoT in South was mainly through non-academic sources such as news articles and blogs. This was iterated also by Dlodlo, Foko, Mvelase, and Mathaba (2012) in a paper titled “The State of Affairs

in Internet of Things Research” under the CSIR Meraka Institute, Pretoria, South Africa (Dlodlo, Foko, Mvelase, & Mathaba, 2012).

5.2.3 Scientific Reflection

The scientific reflection focuses on what this research has contributed to the scientific body of knowledge. This will highlight what can be gained from this research and what was learned.

The aim of the research was to explore the potential use of the IoT in South African retail business to provide guidance to Chief Information Officers (CIOs), Chief Technology Officers (CTOs) or Head of Information Technology (IT) in South African retail businesses on how they can potentially use IoT in their businesses.

The study aims to retail businesses of the potentials of the IoT in South Africa as the next big technology investment. Retail businesses will gather knowledge on the potential uses, how the South African retail environment can use the IoT, its benefits and challenges to make an informed invest, practice, research and policy building in their company. Businesses that are set to be profitable and stay competitive are those that are on par with technological trends and are able to make informed technological decisions at the right time as well as build business models with current technology trends (Kujala, et al., 2011).

5.3 RECOMMENDATIONS

This section discusses the recommendations for practice and theory, further research and further development work.

5.3.1 For Practice

The research revealed that the IoT is the next big technology invest in South African retail. Businesses that will invest in the IoT are set to benefit from its use. Though the IoT presents various challenges, the research revealed that the benefits outweigh those challenges.

Notably, the IoT is still in its infancy in South Africa, lagging behind in the global trend. It is evident that the South African retail still has a big gap to cover in the IoT space, the reality in South Africa is still not as the paradigms of Amazon Go and Monoprix. The South African retail still has to gather knowledge understand the paradigm of the IoT, in order to get the customer to fully interact with the business processes offered by the IoT.

It is important to note that retailers should not consider the IoT as a single technology, but a range of different technologies that are connected through a path or network to achieve a single goal. Technologies that enable the IoT have been in existence for a number of years. For example, one of the core technologies that enable the IoT in retail is RFIDs. RFIDs have been in existence for many years and on its own does not constitute the IoT. However, RFIDs connected to other devices through a network creates the IoT.

The interconnection of devices and things in the IoT is set to change business processes in retail businesses creating new efficiencies for retailers. Businesses that are set to benefit from the IoT are those that are willing to change from traditional processes to processes that fully enable the IoT. The IoT is set to change the normal retail business as we know and the offerings are beyond imagination. Retailers should not aim to look for a single IoT package, but rather they should consider the process they would like to create and therefore, using the IoT paradigm to enable it.

The findings further revealed that the IoT has not become a reality in South Africa and retailers are still waiting. Various research shows that the IoT will be in the point of boom in 2-3 years. If retailers want to harness the potential of the IoT they will have to start investing today in preparation for its boom. Retailers that will wait too long will lose out on their advantage.

Further, the research presented the potential use of the IoT in South African retail businesses. The research is aimed to provide retailers with the use of the IoT while highlighting the benefits and challenges. It is, therefore, no doubt that the IoT is the next big technology investment in South Africa.

5.3.2 For Theory

The research used a deductive approach to reasoning using the TOE Framework as a lens for the research.

Recommendation for Theory:

1. Using a different research framework to explore different constructs the contribute to the use of the Internet of Things in South African retail businesses.
2. The research took a deductive approach to theory. Future research can consider taking an inductive approach or other methods of theory building to gather results for the research topic.

5.3.3 For Further Research

Future research will ensure that emerging results that have not be discussed in this research are uncovered for theory building and/or for practice.

Recommendation for Future research:

1. Conducting a quantitative research approach and gathering responses using a positive view of reality. Positivist collect responses objectively and therefore, they are not part of the data collection method which would likely generate different results.
2. Conducting the research in a different market, rather than retail, as different markets have different dynamics and their response to technology is different.
3. Alternatively, looking specifically at online retailers as their dynamics are different from brick and mortar retailers and might use technology more extensively.
4. In the case where an interpretive study is conducted; a researcher can use a single case study as a data collection method.
5. Further research can be done the potential of the IoT in South African retail, not only focusing on the use but other roles of the IoT in retail.

6. Further research, considering conducting a longitudinal study to collect data over time as opposed to one point in time and potentially increasing the number of respondents exponentially.
7. Further research can be conducted on the underlying factors of this research, i.e. a research can specifically study the benefits or challenges on their own.

The IoT is an emerging technology that is set to change the way retailers in South Africa are conducting business. As previously stated, businesses that are set to survive in the ever-changing technology era are those that will realise the potential technology such as the IoT has for their business. Further research on the subject is required as the IoT is still in infancy stages in South Africa. However, with the passing years this will change and businesses need to be ready to adapt to change to keep their customer base and increase for a better competitive advantage.

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APPENDIX 1: RESEARCH INSTRUMENT

RQ1: What is potential use of IoT in South African retail businesses?

RQ2: How can the South African retail environment potentially use IoT?

Q1: What technologies will be used for IoT in South African retail?

Q2: What business processes will be enabled and affected by IoT in South African retail businesses?

Q3: How will IoT be used in the South African retail environment?

RQ3: What are potential benefits of using IoT in South African retail businesses?

Q4: What technological benefits will IoT have in South African retail businesses?

Q5: What organisational benefits will IoT have in South African retail businesses?

Q6: How will IoT benefit the South African retail environment?

RQ4: What are the potential challenges of using IoT in South African retail businesses?

Q7: What technological challenges will IoT pose in South African retail businesses?

Q8: What organisational challenges will IoT pose in South African retail businesses?

Q9: What challenges will the South African retail environment have when using IoT?

APPENDIX 2: ETHICS APPROVAL



UNIVERSITY OF CAPE TOWN
FACULTY OF COMMERCE
 Igniting Knowledge and Opportunity



Ethics Approval Request for the Study entitled: **The potential use of the Internet of Things (IoT) in South African Retail Business**

Signed by:

	Full name and signature	Date
Principal Researcher/Student: Nomusa Nomhle Dlamini	Signature removed	04/12/2016

This application is approved by:

Supervisor KA Johnston	Signature removed	03/12/2016
Co- Supervisor	Signature removed	

Approved.

7.12.2016

Prof U Rivett Signature removed

Chair

Ethics in Research Committee

Faculty of Commerce

University of Cape Town

Com Ethics_V4

APPENDIX 3: COVER LETTER



Department of Information Systems

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Tel: +27 (0) 21 650 2261 Fax: +27 (0) 21650 2280
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Dear respondent,

I got your email from LinkedIn. I am a student currently studying towards a Master of Commerce (MCOM) degree specialising in Information Systems (IS) at the University of Cape Town (UCT). My dissertation is on the use and the potential use of the Internet of Things (IoT) in South African retail businesses. I would appreciate it if could allow me to have an interview with you for data collection on the subject. I am fully aware that you have a busy schedule, but your responses will be greatly appreciated.

The aim of this research is to explore the use and the potential use of the Internet of Things (IoT) in South African retail businesses. The research will place primacy on the use of IoT in retail businesses in South Africa while highlighting its benefits and challenges. This research has been approved by the Commerce Faculty Ethics in Research Committee. Participation in this research is voluntary. You can choose to withdraw from the research at any time. The interview will take approximately 30-45 minutes. You will not be requested to supply any identifiable information, ensuring anonymity of your responses.

Please note that all the data collected from the interview will be used for the purposes of this research only. Data collection for this research (interviews) runs until the 30th of April 2017. Please kindly consent to participate in this research in writing (via email or in print), please see consent form attached. This is one of the requirements in the Department of Information Systems at the University of Cape Town.

Should you have any questions regarding the research, please feel free to contact me (researcher), details are provided below. If you have concerns or need clarity, please do not hesitate to contact my supervisor, details are provided below.

Looking forward to having an interview with you.

Yours Sincerely,

Signature removed

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Signature removed

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Our Mission is to be an outstanding teaching and research university, educating for life and addressing the challenges facing our society."

APPENDIX 4: CONSENT LETTER



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Research Participant Consent Form

I, _____, consent to participate in the research on use and the potential use of the Internet of Things (IoT) in South African retail businesses.

I am aware that participation is voluntary and that I may choose to withdraw from this study at any time, should I choose to do so.

Signature

Date

Our Mission is to be an outstanding teaching and research university, educating for life and addressing the challenges facing our society."

APPENDIX 5: CONSISTENCY MATRIX

<p>Gregory (2015) stated that IoT is reshaping the retail industry, offering new opportunities to businesses and its customers. The rise of competition in the retail market has resulted in more and more retail businesses using IoT to gain market share (Longo, Kovacs, Franke, & Martin, 2013).</p>					
Sub-problem	Literature Review	Research questions	Source of data	Type of data	Analysis
<p>The first sub-problem is to explore the use and the potential use of IoT in South African retail businesses.</p>	<p>Manyika, et al. (2015) stated that business processes in retail businesses have changed significantly with each passing year and IoT is set to cause more significant changes.</p> <p>The key components that make up IoT are RFID systems, which are made up of readers, which trigger transmission of signals and tags, and are equipped with unique identifiers in the objects, tags, sensors, and actuators (Atzori, et al., 2010; Zancul, et al., 2016).</p> <p>Geschickter, et al. (2015) asserted that if businesses use or plan to use IoT they will have to plan for the reinvention of their business processes.</p>	<p>RQ1: What is the potential use of the IoT in South African retail businesses?</p> <p>RQ2: How can the South African retail environment potentially use the IoT?</p>	<p>Q1: What technologies will be used for IoT in South African retail?</p> <p>Q2: What business processes will be enabled and affected by IoT in South African retail businesses?</p> <p>Q3: How will IoT be used in the South African retail environment?</p>	<p>Semi-structured Interviews</p>	<p>Qualitative Analysis using Thematic Analysis</p>

Gregory (2015) stated that IoT is reshaping the retail industry, offering new opportunities to businesses and its customers. The rise of competition in the retail market has resulted in more and more retail businesses using IoT to gain market share (Longo, Kovacs, Franke, & Martin, 2013).

Sub-problem	Literature Review	Research questions	Source of data	Type of data	Analysis
<p>The second sub-problem is to determine the potential benefits of using IoT in South African retail businesses.</p>	<p>In 2016, Murray et al. stated that IoT is a paradigm in which innovation creates value, by enabling intelligence and communication between humans and machines, while providing a new way of communication and transfer of information. The undeniable and basic benefit of using IoT is its ability to impact and potentially change the everyday processes of its user (Atzori, et al., 2010). IoT offers the ability for businesses to access information about physical objects that were not easily available, this provides more information to businesses which could lead to innovation, high efficiency and productivity (Bi, et al., 2014).</p>	<p>RQ3: What are the potential benefits of using the IoT in South African retail businesses?</p>	<p>Q4: What technological benefits will IoT have in South African retail businesses?</p> <p>Q5: What organisational benefits will IoT have in South African retail businesses?</p> <p>Q6: How will IoT benefit the South African retail environment?</p>	<p>Semi-structured Interviews</p>	<p>Qualitative Analysis using Thematic Analysis</p>

<p>The third sub-problem is to investigate the potential challenges of using IoT in South African retail businesses.</p>	<p>For businesses to fully reap the benefits of IoT, they will need to overcome its challenges and more as the number of connected things is escalating with each passing year (Coetzee & Eksteen, 2011; Dijkman, et al., 2015). Security and privacy remain the most important issues of IoT and are the centre of trust, relationship building and exchange (Weinberg, et al., 2015).</p> <p>Tully (2016) stated that security challenges posed by using IoT remain one of the greatest challenges to businesses. The increase in the use of IoT inevitably increases data attacks on the new devices (O'Neill, 2014).</p> <p>Weber (2015) emphasised that IoT technologies receive and send large amounts of data between devices and therefore are prone to a high-risk when it comes to the privacy of data.</p> <p>The increase in the use of IoT technologies poses capacity and bandwidth challenges causing failures in the networks (Newe, 2015).</p>	<p>RQ4: What are the potential challenges of using the IoT in South African retail businesses?</p>	<p>Q7: What technological challenges will IoT pose in South African retail businesses?</p> <p>Q8: What organisational challenges will IoT pose in South African retail businesses?</p> <p>Q9: What challenges will the South African retail environment have when using IoT?</p>	<p>Semi-structured Interviews</p>	<p>Qualitative Analysis using Thematic Analysis</p>
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APPENDIX 6: TABLE OF ACRONYMS

<u>Acronyms</u>	<u>Full word</u>
CAQDAS	Computer Aided Qualitative Data Analysis Software
CDO	Chief Digital Officer
CIO	Chief Information Officer
CSIR	Council for Scientific and Industrial Research
DOI	Diffusion of Innovation
DoS	Denial of Service
GPS	Global Positioning System
IDC	Industrial Development Corporation
IT	Information Technology
IoT	Internet of Things
IPSO	Internet Protocol for Small Objects
NFC	Near Field Communication
RFID	Radio Frequency Identifiers
SIC	Standard Industrial Classification
SLA	Service Level Agreement
TAM	Technology Acceptance Model
TOE	Technology Organisation Environment
TPB	Theory of Planned Behaviour
UCT	University of Cape Town
UI	User Interface
UTAUT	Unified Theory of Acceptance and Use of Technology
WGIG	Working Group on Internet Governance
WSN	Wireless Sensor Networks