Factors affecting adoption of IoT technology in the supply chain: A case of a clothing retailer in the Western Cape

Garth Styer

(Student number: 2908035)

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Supervisor – Prof. Joel Chigada

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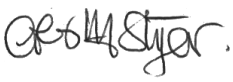
Declaration

I, Garth Styer, hereby declare that *Factors affecting adoption of IoT technology in the supply chain: A case of a clothing retailer in the Western Cape*, is my own original work and that all sources have been accurately reported and acknowledged, and that this document has not previously in its entirety or in part been submitted at any university in order to obtain an academic qualification.

Garth Styer January 2023



Abstract

The retail industry in South Africa (SA) is very competitive and the Western Cape is no exception. In such a competitive retail environment, innovation is often key to a competitive advantage and growth in the business. To that end, the organisation may consider to leverage Internet of Things, or IoT technology to provide a competitive edge. A recurring problem that organisations experience when considering this type of technology adoption, is lack of understanding, and poor appreciation of the ways that IoT technology may be used in Supply Chain Management (SCM). Management's lack of understanding of the factors that affect technology adoption (on the supply chain processes) may furthermore result in failure to harness the technology for a competitive advantage. The motivation for the research study was therefore to uncover, and better understand those factors that affect technology adoption.

Similar studies have been conducted abroad in the United States, China, and Europe, according to the literature reviewed, but none in SA (and more specifically, none in the Western Cape). This research objective was therefore to address and fill that gap in the current academic knowledge.

A positivist research paradigm was chosen so that the research findings of an online survey may be integrated and systematised into meaningful outputs, where conclusions may be drawn through statistical analysis. The output constituted a holistic depiction of the research after data analysis and data interpretation.

The research findings were consistent with literature studies. The research findings furthermore presented adequate information to understand the research problem - which are the factors that affect technology adoption of IoT in SCM. These were found to relate to electricity supply, poor network connectivity, and insufficient training. Lastly, the researcher was able to identify possible recommendations based on study findings.

Results of the research furthermore holds future value as when factors affecting adoption of IoT are considered, then it may serve as a guide for the suitability and feasibility for adoption of the technology in a given retail organisation in the Western Cape region of South Africa.

Keywords:
Digitalisation, Internet of Things, IoT technology adoption, Logistics, Retail, Supply Chain Management, Supply Chain Virtualisation

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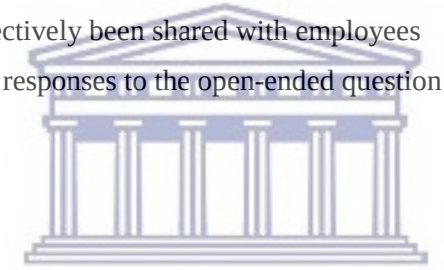

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List of Acronyms

4IR	Fourth Industrial Revolution
AI	Artificial Intelligence
EPC	Electronic Product Code
HSSREC	Humanities and Social Sciences Research Ethics Committee
IoT	Internet of Things
IT	Information Technology
ML	Machine Learning
PI	Principal Investigator
RFID	Radio Frequency Identification
RTA	Readiness for Technology Adoption
SA	South Africa
SC	Supply Chain
SCM	Supply Chain Management
TAM	Technology Acceptance Model
TR	Technology Readiness
TRAM	Technology Readiness Acceptance Model
TRI	Technology Readiness Index
WEF	World Economic Forum

CHAPTER ONE: INTRODUCTION AND BACKGROUND

1.1 Introduction

The retail industry in South Africa (SA) is very competitive and the Western Cape is no exception. This was the location that the research was focused on and conducted in. In such a competitive retail environment, sound business operations and innovation is often key to a competitive advantage and growth in the business. To become more innovative, retailers have therefore considered to leverage Information Technology (IT) and adopt, or implement new business models and processes that cater for online, in-store, as well as mobile customers (Parris, Spisak, Lepetit, Marjanovic, Gunashekar, Jones & Morgan, 2015).

To that end, the organisation would require a well-functioning Supply Chain (SC) to effectively feed and monitor those additional sales channels and processes. It is here that technology may therefore be adopted, implemented, and leveraged to provide a competitive edge and an innovative advantage by aiding to build and maintain this well-functioning SC. This may be brought about by leveraging the Internet of Things, otherwise referred to as IoT technology, to aid in more accurate tracking and reporting in such new and complex technological supply chain environments (Parris, Spisak, Lepetit, Marjanovic, Gunashekar, Jones & Morgan, 2015).

This chapter discusses the contextual setting, statement of the problem, research questions, objectives, significance and research methodology that was used in this study. Before the chapter is concluded, the research provides an outline of the structure of the study.

1.2 Background of the Study

The term “Internet of Things” (IoT) was first used in 1999 by Kevin Ashton to describe a system where the Internet is connected to the physical world by means of ubiquitous sensors. Ashton is the co-founder of the MIT Auto-ID Centre (Tu, 2018). This is where the proposed infrastructure for the Electronic Product Code (EPC) encoding scheme and the EPC global network was developed to enable connections between devices with Radio Frequency Identification (RFID) sensors. The EPC scheme and the EPC global network enables each IoT device to have a unique RFID identifier, which allows for tracking and tracing of these devices on a global scale (Tu, 2018). This specific IoT technology (RFID) will be on the primary focus of this research.

In a broader sense, IoT is a collective technology that comprises of connected networks of sensors and wireless devices that are either accessible remotely across the internet, or where access may be limited only within private networks (Caro & Sadr, 2019). The sensors may detect a wide range of things like temperature, light intensity, geo-location, speed, and altitude amongst others. IoT technology moreover has already impacted industries such as healthcare, manufacturing, building automation, and transportation. The retail industry in contrast, has not experienced the same level of impact and there is therefore potential to use this technology in that space (Caro & Sadr, 2019).

1.3 Statement of the research problem

A recurring problem that organisations experience when considering technology adoption, is lack of understanding and poor appreciation of the applications that IoT technology may be used in Supply Chain Management (SCM) (Caro & Sadr, 2019). This leads to indecision in terms of technology adoption (Caro & Sadr, 2019). Management's lack of understanding of the effects of technology adoption (on the supply chain processes) may result in failure to harness the technology for a competitive advantage. The absence of systems and processes to produce information for that sort of decision-making also affects leadership's motivation to invest in IoT. To reiterate, IoT technology adoption is said to hold much promise and business advantage for an organisation if it were to be successfully adopted (Labombard, Mcarthur, Sankur & Shah, 2019). Caro and Sadr (2019) contend that a clear strategy for transformation is key to successful technology adoption. The research conducted by Caro and Sadr (2019) indicates that transformation initiatives that move ahead with the lack of a clear strategy, may be due to organisations feeling pressure to stay up to date with technology and that the pressure to compete may result in poor and hasty decisions regarding expenditure – leading to financial losses. Conversely, there may also be a reluctance to commit financial resources when a strategy is not clear. This indecision is key to the problem.

1.4 Research Questions

What factors affect the adoption of IoT technology in Supply Chain Management of a large clothing retailer in the Western Cape?

Research sub-questions:

1. What are the effects of IoT technology adoption on processes in the SCM of a large clothing retailer in the Western Cape?
2. What interventions may be applied to improve the adoption of IoT technology in SCM of a large clothing retailer in the Western Cape?

1.5 Research Objectives

1. To identify factors affecting the adoption of IoT technology in SCM of a large clothing retailer in the Western Cape.
2. To ascertain the effects of IoT technology adoption on the SCM processes of a large clothing retailer in the Western Cape.
3. To identify interventions that may be applied to improve the adoption of IoT technology in SCM of a large clothing retailer in the Western Cape.

1.6 Aim of the Study

The aim of the study is to identify and understand the factors that affect the adoption of IoT technology in supply chain management in the setting of a large clothing retailer in the Western Cape. In addition, the study aims to ascertain the effects of IoT technology adoption, and the interventions that may be applied to improve the adoption of IoT technology in SCM of a large clothing retailer in the Western Cape.

1.7 Contribution of the Study

This study contributes to the body of academic knowledge relating to the topic of IoT technology adoption in supply chain management, and specifically how it is utilised and received (or perceived) by the stakeholders in a large retailer in the Western Cape in South Africa. Executive management of large retailers in SA could benefit from the findings of this study as it furthermore provides insights into technology adoption methods and its effectiveness when looking at the IoT implementation as a case study in a large retailer in South Africa. This contribution may help further future academic research in this area and fill the gap where similar studies have been performed in other countries besides South Africa.

1.8 Research Design and Methodology

1.8.1 Research paradigm

A positivist research paradigm was chosen for this research so that the research data could be systematised and categorised into meaningful outputs, and that conclusions and explanations could be drawn through interpretation and analysis.

1.8.2 Research methods

The research method chosen for this study was quantitative which allowed survey data collection. Collected data was presented in statistical and mathematical format.

1.8.3 Research approach

The research approach for this study was deductive in nature that uncovered the factors affecting technology adoption. The idea was to analyse and interpret the quantitative data from the survey to this end.

1.8.4 Research strategy

A research strategy entails the steps that are undertaken by the researcher giving direction to the efforts in order to conduct the research systematically (Saunders, Lewis & Thornhill, 2019). Various strategies include surveys, case studies, experiments, action research, grounded theory and ethnography. An online survey strategy was chosen for the data collection. The survey was one of the most economical strategies that allowed for collection of a large amount of data from multiple respondents / participants spread across varied locations in SA.

1.9 Organisation of the Study

This study comprises five chapters organised as follows:

Chapter One provides the introduction and motivation for conducting this study. By outlining the problem statement, the intention is to highlight the presence of a management problem worth of an investigation. In this introductory chapter, the primary research question and associated research objectives are presented. An overview of the research design and methodology is discussed.

Chapter Two of the study focuses on past studies or literature that supports or refutes arguments raised in the present study. It is important to look at what others have said in similar or closely-related studies to gain insights into the methodology, results and implications of the findings and recommendations. Ideas from other scholars help synthesize and generate new knowledge in the current study, therefore, literature review is an important step in the research process.

The research methodology and design are discussed in Chapter Three. Researchers adopt a carefully thought out research process to ensure that data is collected, analysed and interpreted to make informed decisions. Various concepts that form the research design and methodology are also discussed showing how they complement each other.

In Chapter Four the research findings are interpreted and discussed. The researcher presents the quantitative findings using appropriate tools and techniques commensurate with quantitative data.

In closing, conclusions from the study are presented, followed by recommendations in the last in Chapter Five. In addition, recommendations for future research, implications for policy and practice, limitations and contributions of the study are presented in this last chapter.

1.10 Chapter summary

This chapter set the background and context for the study. IoT technology was introduced, explained, and described. Examples were given how the technology may be used in supply chain management to achieve a competitive advantage through innovation, tracking, and reporting. The research problem was clarified, outlined, and identified as an indecision or reluctance on the part of organisations to adopt the technology. The research is meant to explain why this indecision or reluctance to adoption exists, and furthermore whether the technology is a help or a hindrance to business processes in supply chain management. The research design and methodology were furthermore outlined, explained, and tied to the main research question. The next chapter reviews literature pertaining to IoT and related concepts.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter reviews various scholarship on the concept of Internet of Things and other related issues that ground the understanding of the current study. The first section of the chapter briefly discusses the theoretical framework guiding this study, followed by an overview of the Fourth Industrial Revolution (4IR), which cascades the discussion to the Internet of Things (IoT) followed by a discussion of factors that affect its adoption by a large clothing retailer in the Western Cape. The perceive effects of IoT technology adoption on the supply chain processes are presented. The chapter concludes by discussing the possible interventions that are used by companies to improve technology adoption.

2.2 Theoretical framework guiding this study

Theoretical frameworks are important components of research because they allow the researcher to better understand and explain the problem at hand (Chigada, 2022). Ngulube (2021) states that a theoretical framework connects the researcher to existing knowledge. With a theoretical framework, the researcher is forced to address the research questions of why and how. Leedy and Ormond (2019) assert that theoretical framework helps to clarify the implicit theory in a manner that is more clearly defined. Researchers use theoretical frameworks to consider other possible frameworks and reduce biases that may sway one's interpretation. For this study, the Technology Readiness Adoption Model (TRAM) was analysed and deemed fit for the study.

2.2.1 Technology Acceptance Model

The TRAM was conceptualised as a combination of the Technology Adoption Model (TAM) and Technology Readiness (TR) models. The limitation of the TAM is that it was initially designed to predict technology adoption in work environments thus making it less applicable to environments where consumers have a higher autonomy (Lin, Hsin-Yu, & Sher, 2007). TRAM furthermore addresses the issue of the consumer adoption of e-services.

The idea underpinning the TRAM is that an individual's personality generally influences the potential acceptance of technology. TR involves people's propensity to embrace and use new technologies for accomplishing personal or work-related goals (Parasuraman A. , 2000). The TR index (Parasuraman, 2000) follows this concept or idea. Technology readiness can therefore be viewed as a scale, or a readiness measure, resulting from four personality dimensions: optimism, innovativeness, discomfort, and insecurity. According to Parasuraman

(2000) these personality dimensions affect people's tendency to embrace and use new technologies. In this respect, optimism and innovativeness function as mental enablers, while discomfort and insecurity function as mental inhibitors to accepting new technologies. Mental enablers and inhibitors in people's minds can collectively determine a person's disposition to use or resist new technologies.

Users of technology are influenced by various factors to adopt or resist new technology. Resistance to new technologies will not stop the diffusion of innovations, and it is entirely the responsibility of firms to inculcate a culture and mindset among employees towards acceptance of technologies (Davis, 1989). In addition, the technological environment is dynamic and as such businesses need to embrace technologies. For example, the emergence of the global pandemic coronavirus 2019 (COVID-19) changed the way businesses and people operate and live. Many firms have been severely affected by the global pandemic, resulting in some reconfigurations of business models and strategy. In all the reconfigurations, technology strategy has been given considerable attention (Schwab, 2016).

Readiness can also be determined by establishing if users will adopt the tools in their daily practice. Research demonstrates that the implementation and supporting of new technology is an expensive project. Given that South Africa is experiencing its worst power outages, the economy is in tenterhooks. Therefore, it is best for managers to understand the likelihood of successful adoption before embarking on a reform. This evaluation is imperative because managers can identify issues that may need to be addressed to facilitate successful reform (Karp & Fletcher, 2014).

The organisation should assess its culture's readiness by clarifying its mission by establishing clear communication channels and strategies. The decision-making process should involve all stakeholders and that management should communicate any change initiatives to everyone in the company (Karp & Fletcher, 2014). With reference to the project level, it is important to adopt a project-based approach when managing work assignments (Steyn & Nicolas, 2012).

Parasuraman (2000) indicates that the belief that technology can change and improve efficiency should be some of the factors considered by business in their approach to readiness. First, the firm must be convinced that it requires new technology because it supports the overall strategic direction of the firm. This is important because it helps managers to identify and purchase the right technology which supports, or can be integrated with, existing systems. The researcher has been involved in similar processes to determine organisational readiness. The objectives

for new technology adoption can include restructuring its processes, and reconfiguring its architecture with the intention of improving efficiency and product quality.

In figure 2.1 below, the illustration indicates what a firm needs to consider for itself to be ready for technology adoption, which is encompassed of four dimensions.

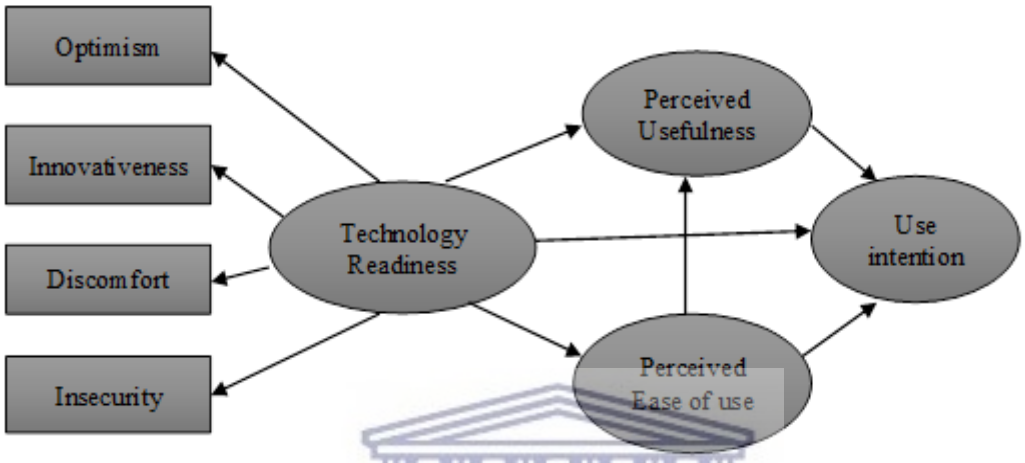


Fig 2.1 Technology Readiness Adoption Model (TRAM) (Lin, Hsin-Yu, & Sher, 2007)

The dimensions depicted in figure 2.1 consists of four sub-dimensions as follows:

- ***Optimism*:** This is the positive view of technology and a belief that new technologies will increase control, flexibility and efficiency. This is closely related to the perceived usefulness of technology within the Technology Acceptance Model (TAM).
- ***Innovativeness:*** The tendency to be a technology pioneer and thought leader. Innovativeness is equated to early adopters within the Diffusion of Innovation [DoI] (Lin, Hsin-Yu, & Sher, 2007).
- ***Discomfort*:** These are perceived attributes of lack of control regarding technology and the sense of being overwhelmed by it. High complex features of technology can be intimidating because the user might endure learning costs.
- ***Insecurity:*** Distrust of technology and the disbelief about its ability to work properly (Parasuraman A. , 2000).

The TRAM has been widely used by many industries in an attempt to establish their level of readiness to adopt and implement technologies. In this study, the level of readiness is

determined by the amount of information organisations are exposed to regarding the benefits and costs of IoT devices.

2.3 Overview of the Fourth Industrial Revolution

The Fourth Industrial Revolution (4IR), a term coined by the World Economic Forum (WEF) in 2016, is regarded as an advancement of the Third or Digital Revolution. While earlier Industrial Revolutions focused on efficiencies, processes and production, this new Revolution augments the focus on mental tasks, as the line between people and technology becomes blurred (Brynjolfsson & McAfee, 2014). As organisations are faced with the unfolding of the 4IR, they are looking for ways to harness new technologies in an effort to increase efficiency, expand into new markets and attract new customers who are increasingly adopting digital technologies (Schwab, 2018). This technological revolution "has fundamentally altered the way people live, work, and relate to one another" (Schwab, The Fourth Industrial Revolution, 2016). The 4IR is disrupting almost every industry globally and the entire systems of production, management and governance is being transformed. The World Economic Forum predicts that while 75 million jobs worldwide will be displaced by automation in the next several years, whilst 133 million new jobs will be created (Cann, 2019).

With the evolving technologies, and through historic industrial revolutions, the nature and role of many organisations has evolved, and will continue to evolve over time (Greiner, 1988). Jakšič and Marinč (2015) state that organisations in South Africa and globally are encountering technological innovations and that Information Technology is drastically changing the way that business is done. Those firms embracing the Digital Revolution are doing so, to survive, and ideally to thrive (Jakšič & Marinč, 2015). Schwab (2018) suggests that customers are the epicentre of the economy and companies should embrace emerging technologies with a focus on serving customers.

Advanced technologies that have altered the way businesses are operating include the Internet of Things (IoT), Machine Learning (ML) and Artificial Intelligence (AI) and blockchain. Technological innovations have undoubtedly changed and shaped the way people live and how businesses operate, ushering in the global village into the information age. This group of technological innovations is collectively referred to as the Fourth Industrial Revolution (4IR). Industries, large or small, are moving towards the adoption of technologies to improve quality and efficiency. The critical question therefore, relates to the level of preparedness of organisations in the supply chain management sector for the 4IR.

2.4 Internet of Things

'IoT' can be defined as the interconnection of computing devices enabling them to send and receive data through the Internet (Morgan, 2019). IoT is an increasingly global topic in the workplace and beyond. Its emergence has impacted how people live, how firms operate and communicate with their customers and among themselves. However, there are a lot of complexities around IoT such as people grappling to grasp the foundation of the concept. IoT will impact businesses, people and government in various ways. With reference to the adoption of IoT, there is an acceleration of innovation and velocity of disruption which are hard to understand (WEF, 2016). There is a huge paradigm shift in the supply chain process for instance because technologies are enhancing efficiency, collaboration and enabling managers to develop seamless solutions for their customers (Morgan, 2019).

Schwab (2018:1) posits that "we stand on the brink of a technological revolution that will fundamentally alter the way we live, work, and relate to one another. In its scale, scope, and complexity, the transformation will be unlike anything humankind has experienced before". This means that there is a massive drive towards new technological innovations by firms and people. The critical question that arises is, "To what extent are SCM retailers aware of all these technological benefits"? The rate at which these innovations are taking place is unprecedented. Therefore, firms need to keep abreast with rapid technological developments. This is achieved through the adoption of digital technologies that assist businesses in changing their business model, exploiting new revenue streams and provide new opportunities (Gartner, 2022).

Due to the proliferation of and ease of access to information, customers are increasingly empowered (Jakšič & Marinč, 2015). Technology can assist SCM's in expanding their digital offering and in reaching new customers. As businesses adapt and require new skills and operational procedures, the threat of mass retrenchment and unemployment is real. The solution cannot simply be the introduction of mass education. (WEF, 2016) cites employer complaints of graduates who have to be re-trained as the newly hired employees are lacking the skills required in the modern age. (Monger, 2015) suggests that companies with employees who continue to function in established ways, may turn out to be the losers in this digital revolution.

The emergence of 4IR moreover has the potential to raise global income levels and improve the quality of life for populations around the world (Schwab, 2018). Companies embracing and implementing the latest technologies have been confronted with challenges relating to the

shortage of computer engineering skills, financial resources and alignment of these technologies with existing organisational strategies and technologies (Probst & Scharf, 2019). However, consumers have benefited the most because companies are reconfiguring their architecture to innovate products and services with shorter turn-around times. In addition, consumers are accessing the digital world. Efficiency on productivity has been the focal point of 4IR (Probst & Scharf, 2019).

Although the advent of technology is beneficial for businesses, it is acknowledged that new technologies are posing privacy and confidentiality challenges (Chigada & Kyobe, 2018). The emergence and wide use of Information and Communication Technologies (ICT) is also creating opportunities for cybercriminals. As technologies become sophisticated so are cybercriminal syndicates (Orji, 2018). Companies properly embracing technology in this second machine age are winning and those trying to win through traditional business methods are losing" (Monger, 2015:1). (Prahalad & Bhattacharyya, 2011) suggests that organisations implement solutions that require the least number of trade-offs where organisations have the appropriate competencies and technology, and the products and services are suitably customized**.** According to Porter and Heppelmann (2015), they contend that electronic products are evolving into intelligent, networked devices. As these devices are becoming more embedded within larger systems it is reshaping the way organisations do business.

To better understand how intelligent, networked devices are changing the way business is conducted, an understanding of their inherent components, technology and capabilities may be required. These devices share 3 core elements. Physical components (mechanical and electrical), Smart Components (sensors, micro-processors, data storage, controls, software, embedded operating systems, digital user interfaces), and Connectivity Components (ports, antennae, protocols and networks). The combination of these components/elements enable communication between the device (also referred to as the product) and the product cloud (Porter & Heppelmann, 2015). These connected products furthermore require a supporting technology infrastructure (also referred to as the Technology Stack) to serve as a platform for data exchange between the products and the user. The platform is also used for data storage, analytics, applications, and the platform furthermore controls access to the products and the data exchanged between them (Porter & Heppelmann, 2015).

This platform, or infrastructure, enables new capabilities for the organization. 1 - Products monitor and report their own statuses as well as that of their surrounding environment. After

analysis it may provide deeper insights about their performance and usage. 2 - Operations on products may be executed remotely so proximity to devices or products is no longer a concern. 3 - Monitoring of the data exchanged between devices and remote control allows for optimization. Algorithms run on data may predict how to improve performance, utilization, and uptime. 4 - Combinations of data monitoring, remote control and optimization algorithms paves the way for autonomy. Products can then "learn" from the environment and user preferences to service themselves and operate on their own (Porter & Heppelmann, 2015).

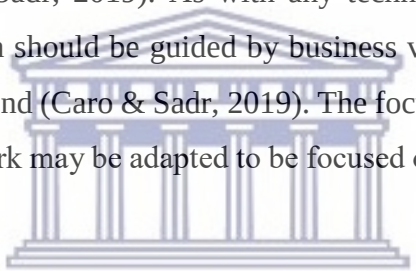
Electronic devices in a fleet of cars or trucks may for example stream data about their operation, location, and environment to their manufacturers cloud systems, and manufacturers may in turn stream software updates back to the cars to enhance performance, or prevent issues before they occur. The relationship between the manufacturer, their products, and the customer is therefore becoming continuous and open-ended. Core functions including product development, IT, manufacturing, logistics, marketing, sales, and after sales service are all being impacted by this shift in the relationship, and this is also making way for new and emerging functions such as data management (Porter & Heppelmann, 2015). The authors contend that it is the most significant change in manufacturing processes since the second industrial revolution that took place more than 100 years ago.

Supply Chain Virtualisation: This is a concept where the actual SC is observed not in a physical sense, but rather as a representation of the SC modelled by the data provided by IoT networks (Verdouw, Beulens & Van der Vorst, 2013). The researchers are of the opinion that virtual objects (or the digital representation of physical objects in the SC) and their simulated interactions are going to be a key technology that will revolutionise the industry. Digital Twins are examples of this virtualisation technology (Qi, Tao, Zuo, & Zhao, 2018). Virtualisation is furthermore a modelling technique, where the actual observation of the physical object is many times not required. It therefore allows for 'observation' in any location where the data from the IoT platform can be streamed to. Historical states of the IoT network can also be reproduced for analysis. Future states and even imaginary states may also be simulated to test the effect of changes in the IoT environment (Verdouw, Beulens & Van der Vorst, 2013).

A network of IoT devices can be thought of as a connected platform that generates data. For this data to provide business value it needs to be accurate, reliable, and easily understood by the business users. This connected platform furthermore extends to all stakeholders of the SC,

as an enabler of a real-time view of SC operations (Parris et al., 2015). The purpose being to make the data available for reporting, systems integration, and decision making.

IoT technology adoption strategy: There are many options to consider when an organization embarks on adopting IoT technology as an enabler in their business. A clear business strategy is therefore the key to success (Caro & Sadr, 2019). Without a clear strategy, the business may be setting itself up for failure and financial losses. In one scenario the organisation may feel pressured to stay up to date with technology and invest heavily in the venture. The organisation may then end up with bloated IT budgets that fail to add a proportionate value to the bottom line (Caro & Sadr, 2019). Another scenario may be one where the organisation cannot articulate or strike a balance between justification of the expenditure and the return on investment affecting the bottom line. These organisations may prefer to wait on a proof of concept, or a framework to follow before making significant investment. The problem is that the proof of concept many times comes from a competitor, leaving the organization at a disadvantage being too late to catch up (Caro & Sadr, 2019). As with any technology, the development of a successful strategy for adoption should be guided by business value creation. Caro and Sadr developed a framework to this end (Caro & Sadr, 2019). The focus was on supply and demand in retail SCM, but this framework may be adapted to be focused on other 'areas of impact' like transport logistics for example.



The idea behind the Opportunity Map in Fig.2.4.1 is to consider and categorise each IoT opportunity based on its perceived capabilities and value it may create. The capability then needs to be labelled either as an 'enabling' or 'enhancing' capability. Enabling capabilities create value by allowing the organisation to perform a current task more efficiently, where an enhancing capability creates value through new opportunities unique to IoT technology.

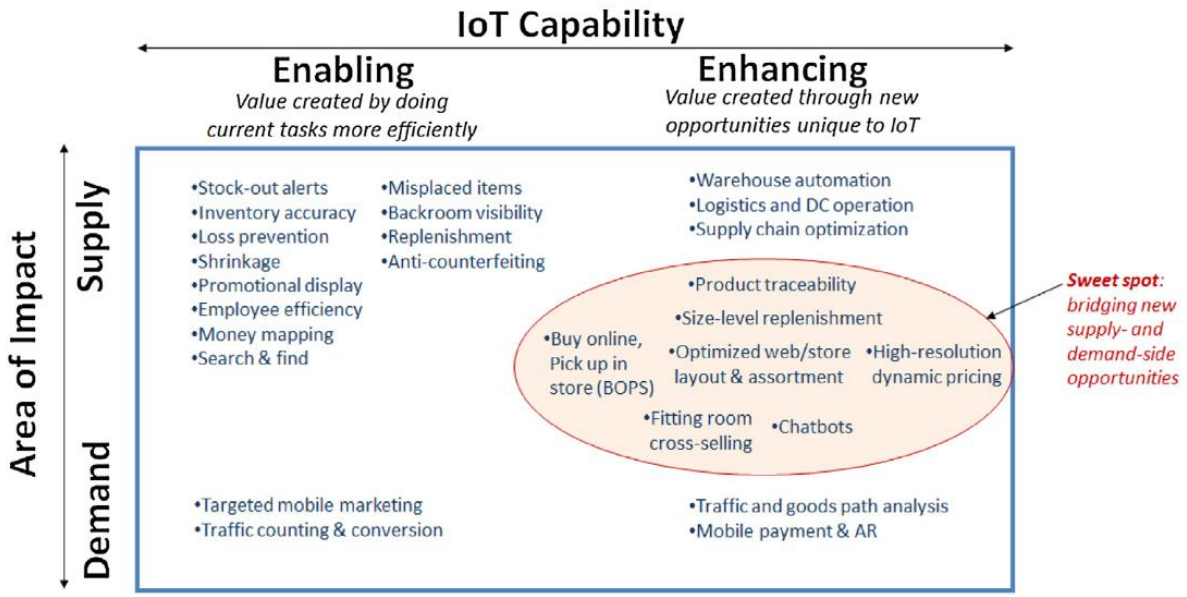


Fig.2.4.1: Opportunity Map for an effective IoT Strategy (Caro & Sadr, 2019)

Typical areas according to (Digiteum, 2019) that may be considered for business value creation could include:

- Real-time asset tracking regarding the geo-location of the product and the transportation environment allows for more accurate forecasting of delivery schedules.
- Monitoring of the storage conditions of the product as it moves from place to place – temperature, humidity, and air pressure for example could compromise the integrity of the product. The organization then also builds an audit (from the data) that may be referenced in case there are issues where compliance may not have been met.
- Real-time location of goods in the warehouse enables faster picking times, as knowing the exact location (or aisle and rack) saves time. This process may be enhanced with an automated machine that retrieves the product on the shelves with no human interaction. The organization then has an informed choice to make regarding the expenditure.
- Contingency planning for transportation routes may be enhanced by taking real-time information into account regarding road accidents, traffic density, or any other incidents that may delay the delivery schedule. Real time alerts also improve the speed at which the risk to the schedule is mitigated.

2.5 Challenges faced in the adoption of IoT technology in SCM and Logistics

The literature indicates that there are certain challenges to the adoption of IoT that tend to recur. The main ideas have been listed below.

Skills Gap: Extensive training is required for managers, warehouse staff, and vehicle drivers. Skilled IT staff may also be required to implement, maintain and support IoT solutions. Data Security and Data Management and governance may also require highly skilled staff that are not always available in the market (Digiteum, 2019). Manpower (2012) states that due to South Africa's poor education system, there is a skills shortage that holds back the rate of innovation. Rather than investing in innovations and upskilling of staff, in order "to ensure that they survive, many companies have focused most of their efforts on managing costs" (Manpower, 2022).

Connectivity Issues: Although an IoT architecture can be private, in most cases it relies on the Internet for connectivity. A stable and reliable internet connection with high bandwidth is therefore required for smooth operations. This also introduces risk to the organization as it makes for a single point of failure in business operations (Digiteum, 2019).

Security: The demand for IoT technology is ever increasing. IoT technology vendors providing this service, at times rush the implementation and sometimes don't give enough attention to the security and protection of the data passing between devices in the network. This may become an issue as the IoT devices cannot be upgraded or patched like conventional computers and application software. The devices are essentially hardwired to perform a specific function. If the network is ever breached by a cyber-attack or compromised then it becomes a difficult challenge to fix and address the vulnerabilities (Kimani, Oduol & Langat, 2019). More attention should therefore be given to security considerations, given that cyber-attacks are becoming more sophisticated and more frequent. A secure IoT architecture is thus vital as data breaches and cyber-attacks could severely compromise the organizational reputation and lead to significant loss of revenue. Chigada & Madzinga (2021) state that overreliance on ICT is creating windows of opportunities for cybercriminals to engage in nefarious acts leading to data breaches and other security risks for many organisations.

The Human Aspect: A typical supply chain is fundamentally a human endeavour of hundreds of individuals across multiple organisations combining their efforts for a common objective. These individuals all have their own motivations, limitations, preconceptions, biases and incentives. It is therefore very challenging for these individuals to execute operations against digitalized demand forecasts generated by IoT, Artificial Intelligence (AI), and Machine Learning (ML) software applications (Mcarthur, Sankur, Shah & Singh, 2020). Approaches to digitalization that are inclusive of people, and work along with them, tend to have more impact, are easier to implement, and become more sustainable over time (Mcarthur Sankur, Shah & Singh, 2020). (Biekpe, Asongu, & Tchamyou, 2018) notes that as companies move to automation, the first jobs to be lost are those of unskilled workers. This creates a challenge to organisations, as employees are reluctant to embrace or adopt technological innovations that they perceive to be as a threat to their employment.

The rapid rate of technological innovations in the global space, strategic decisions regarding innovation, and the increasing complexity of the businesses and technology ecosystems, are all impacting the types of innovations being developed and the rate at which those innovations are being adopted (Omarini, 2017). It is therefore, important for business leaders to understand the technological environment and its effects on their operations.

Research conducted shows that there are various factors at play impeding firms from adopting and implementing IoT. As pointed out earlier, IoT is a disruptive innovation that is forcing many firms to restructure and dictate future processes and market mechanisms (Gartner, 2015). Understanding these factors that drive firms' decisions towards adoption and implementation of IoT is pertinent because it provides insights into how managers estimate the trend of digitisation and what is the overall value of IoT to the company's performance. Managers tend to ignore trends and events occurring around them in their industries and competitors. O'Halloran & Kvochko (2015) assert that IoT has the potential to optimise business processes in production, research and development while driving down connectivity costs.

When there is lack of knowledge and appreciation that IoT has business relevance in today's business world, which is characterised by competition and subsequent pursuit of competitive advantage, managers would not see the value of IoT. Porter and Heppelmann (2015) posit that with the adoption of past technological evolutions, early adopters achieved significant time advantages while laggards lost market share.

Porter and Heppelmann (2014) state that if managers are unable to align IoT with strategy this is adequate enough reason to avoid IoT. The opposite is true for managers who realise the enormous potential of IoT so there are concerted efforts to make strategic decisions in light of IoT (Yokoi, 2010). The researcher believes that if an organisation is not ready for IoT, it would be difficult to adopt and implement it. Human, financial, technological, knowledge and information resources might not be available in the organisation, which is an indication that the organisation is not ready.

2.6 Effects of IoT technology adoption on the SCM processes

The emergence of 4IR has the potential to raise global income levels and improve the quality of life for populations around the world (Schwab, 2018). Companies embracing and implementing the latest technologies have been confronted with challenges relating to the shortage of computer engineering skills, financial resources, and alignment of these technologies with existing organisational strategies and technologies. However, consumers have benefited the most because companies are reconfiguring their architecture to innovate products and services with shorter turn-around times. In addition, consumers are accessing the digital world. Efficiency on productivity has been the focal point of 4IR (PwC, 2016).

Due to the proliferation of, and ease of access to, information, customers are increasingly empowered (Jakšič & Marinč, 2015). Technology can assist SCM organisations to expand their digital offering and reaching new customers. Industries, large or small, are moving towards the adoption of technologies to improve quality and efficiency. Firms embracing the Digital Revolution are doing so, to survive, and ideally to thrive (Jakšič & Marinč, 2015). Schwab (2018) suggests that customers are the epicentre of the economy and companies should embrace emerging technologies with a focus on serving customers.

2.7 Interventions to improve the adoption of IoT technology

There are different interventions that can help managers to improve IoT adoption and implementation. The first intervention is for managers to accept their limited knowledge and understanding of new technologies. Therefore, help from consulting firms with technological expertise and knowledge will offer all necessary support (Porter & Heppelmann, 2015). Knowledge can be enhanced through research, attending seminars and conferences such as those hosted by the WEF or symposia where debates about technology are explored in-depth.

The use of maturity and readiness models is crucial in instances where organisations are not certain if the adoption of specific technologies occurs at the right time and in line with strategic objectives. Karp and Fletcher (2014) suggest the Readiness for Technology Adoption (RTA) framework as a strategic management tool for evaluating an organisation's readiness. Self-assessments are imperative as these help firms to identify areas that may need attention before adopting IoT.

It has been stated that South Africa is confronted with a shortage of IT skills (DHET, 2022). This challenge can partially be addressed through hiring consulting firms with expertise and establishing training centres. However, companies can alternatively develop in-house training or on-the-job training such as apprenticeship. Experienced IT personnel can mentor less-experienced colleagues. Chigada & Ngulube (2014) posits that mentorship is an effective knowledge-sharing and acquisition strategy that enhances succession plans in the firm. McKinsey and Company (2019) states that by 2030, digitisation and automation could result in a net gain of 1.2 million jobs in South Africa provided companies act swiftly and there is a paradigm shift. There are also fears that technology will create job losses, yet there is evidence from past research that demonstrates that technology-related gains can triple South Africa's productivity growth, more than double the country's per capita income and add more real GDP growth rate (DHET, 2022). Firms need to change the way they do things in their business strategy, skills development, and ways of working.

2.8 Empirical studies on the adoption of IoT technology in SCM

Wamba and Boeck (2008) conducted a study that tested various scenarios integrating RFID and the EPC network to evaluate their potential as enablers of information flow in a retail supply chain. The research design was a mixed-method exploratory longitudinal study. Data collection consisted of both qualitative and quantitative data from focus groups, on-site observations, interviews, and time-motion measurements of business processes. The results indicated that the technology could provide and improve information flow within the supply chain (Wamba & Boeck, 2008).

Papert and Pflaum (2017) conducted research in Germany with the objective to develop a theoretical framework for an IoT ecosystem model. The value of the research was intended to support logistics organizations with recommendations for the design of IoT ecosystems tailored

for their businesses. The grounded theory methodology was used to develop the theoretical model that defined the business roles and relationships in the ecosystem design. The authors' findings of the research help organisations to understand the required roles and partners for implementation of IoT ecosystems in their businesses (Papert & Pflaum, 2017).

Tu (2018) conducted a mixed-method exploratory study in Taiwan to understand incentives and concerns that influence decisions to adopt IoT in logistics and SCM. Qualitative analysis using the grounded theory methodology was used to uncover participants' perceptions about logistics innovation through the use of IoT technology. This was then combined with quantitative analysis of data collected from surveys completed by managerial staff. After data collation, structural equation modelling with partial least squares path modelling was used for data analysis. The results of the study indicated that perceived costs and benefits, as well external pressures are significant determinants that influence the adoption of IoT technology, where the technology itself is not as significant (Tu, 2018).

These are some of the many studies reviewed as part of the body of literature, but there were no studies found of this nature conducted in South Africa. This is an indication of a gap in the research and justification for the proposed research to expand and develop the body of knowledge in this area for a large retailer in the Western Cape in South Africa.

2.9 Chapter summary

This chapter discussed the theoretical framework that underpinned the study. The TRAM was deemed suitable because it helped situate this study in specific scholarly discourse, thus, enabling the researcher to explain the problem under investigation. Technology adoption is a complex process that requires firms to align their technology with organisational strategy. In addition, investing in new technology is a strategic decision that should be supported by the vision and mission of the organisation. An overview of the 4IR demonstrated that the world is operating in a disruptive environment where technological innovations have altered the way business and people operate. The chapter highlighted the benefits, impediments and interventions of improving adoption of IoT. The last section of the chapter drew some lessons from empirical studies conducted elsewhere and it was demonstrated that there were long-term benefits of automated processes using IoT. In the next chapter, the research design and methodology of the study will be explained.

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

The purpose of this chapter is to discuss the research plan and processes undertaken in data collection, analysis and interpretation. The different concepts that form the research procedures which include the research paradigm, research design, research strategy, methodological choice as well as research methods. Figure 3.1 below, "The Research Onion" will be used as reference to develop this chapter. Saunders (2007) developed the research onion in an attempt to elucidate the research process. (Al Zefeiti & Azmi Mohamad, 2015) state that Saunders (2007) viewed the research process as the unwrapping of an onion, layer by layer. And furthermore, that in order to see the inner-most layer, the outer layer has to be unwrapped first. This is the logical sequence in the process.

3.2 Research Philosophy

A paradigm is a set of assumptions and perceptual orientations shared by members of a research community (Kuhn, 1970). These assumptions determine how members of a research community view both the phenomena their particular community studies and the research methods that should be employed to study the phenomena (Given, 2008). As shown in Figure 3.1, there are different philosophical assumptions - positivism, realism, interpretivism and pragmatism. Positivists believe that knowledge is obtained from nature through an objective ontological stance, whilst interpretivist are of the view that researchers gather knowledge through a subjective ontological stance. Therefore, it means that positivists obtain, analyse and present data numerically to test what is already known (Leedy & Omrod, 2019). While, interpretivists collect data that is analysed, interpreted and presented in word format to generate new theory.

The pragmatic paradigm refers to a worldview that focuses on "what works" rather than what might be considered absolutely and objectively "true" or "real" (Frey, 2018). Instead, it accepts that there can be single or multiple realities that are open to empirical inquiry (Creswell & Plano Clark, 2011). Instead, it accepts that there can be single or multiple realities that are open to empirical inquiry (Creswell & Plano Clark, 2011). In order to conduct this study, the researcher's philosophical assumptions were considered and clearly articulated because these assumptions informed the entire research (Guba & Lincoln, 1994; Creswell & Plano Clark,

2011). The five fields of enquiry for this thesis were ontology, epistemology, axiology, rhetorical and methodology. Guba and Lincoln (1994) state that when addressing questions relating to the forms of reality, researchers use ontology to answer what can be or not be observable about reality. While epistemology focuses on "how" reality can be observed that is, if it can be observed and the relationship between the researcher and this reality (Guba, 1990). Axiology addresses the role and value of the researcher in the study (Bryman A, 2015). Rhetorical means the use of language when describing this reality (Chalmers, 2002). Guba and Lincoln (1994) and Chalmers (2002) state that the methodological field of enquiry describes the research procedures, tools and techniques used to investigate and discover this reality.

Chalmers (2002) defines ontology as the study of being, that is, reality is constructed within the human mind. Different people perceive reality in different ways, thus, there is no one "true" reality. Deng, Tang, Zhang, Yang and Chen (2012) state that ontology is an explicit formal specialisation of a shared conceptualisation. Holden and Lynch (2004) assert that in any research, two spectrums of ontology (objectivism and subjectivism) guide the view of reality. Reality is out there and is independent of the human mind.

Denzin and Lincoln (1994) and Chalmers (2002) define epistemology as the theory of knowledge and the relationship between the observer and this reality. Guba and Emmanuel posits that the philosophy of knowing (epistemology) focuses on "how" reality can be observed (that is, if it can be observed) and the relationship between the researcher and this reality (Guba, 1990; (Emmanuel, 2019). Saunders, Lewis and Thornhill (2019) state that epistemology is a fundamental assumption that describes the processes of creating, acquiring and communication of knowledge.

Bryman and Bell (2017) and Saunders, Lewis and Thornhill (2019) converge on the understanding that axiology relates to the role and values of the researcher in the study. The aim of the research should be clearly articulated; therefore, the researcher should be conversant with the research procedures such as designing the research plan, instrument development, obtaining gatekeepers' permission, ethical clearance, conducting the survey and performing data analysis. In this study, the researcher was the principal investigator (PI), and undertook all steps from inception to the end of the research study. In addition, the researcher acted in a value-free and unbiased manner, that is, personal opinions, beliefs or experiences did not influence the reality of nature (Tu, 2018).

Guba and Lincoln (1989) state that the use of language is imperative in research because it helps the audience to decipher between personal and impersonal and context-based language. Rhetorical means the use of language (Chalmers, 2002). In support of the concept of a value-free and unbiased manner, the researcher was careful in the selection and application of words and language in this study. Therefore, impersonal, formal and rule-based language was used in this study. A professional writing style using the English language was adopted. The researcher did not use colloquialisms, or first-person pronouns.

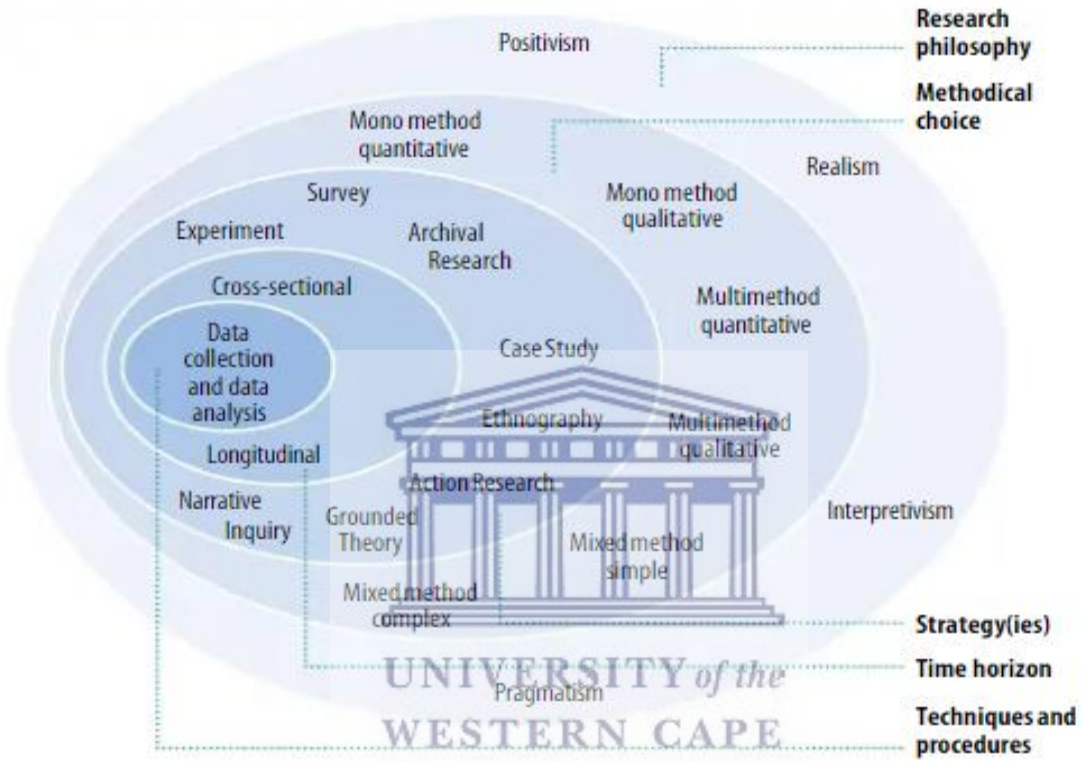


Fig 3.1 –Research Onion Model (Al Zefeiti & Azmi Mohamad, 2015)

3.3 Research Design

Research design provides the overall structure for the procedures the researcher follows, the data the researcher collects, and the data analysis the researcher conducts (Leedy & Ormond, 2016). Lavrakas (2008) defines research design as a general plan or strategy for conducting a research study to examine specific testable research questions of interest. De Vaus (2001), posits that the function of a research design is to ensure that evidence obtained enables us to answer the initial question (research question) as unambiguously as possible. Rassel, Leland, Mohr and O'Sullivan (2020) offer two definitions of research design: specific and general.

With general referring to the plan for the study's methodology and specific referring to the type of study to be conducted.

Research can be designed to fulfill either an exploratory, descriptive, explanatory or evaluative purpose, or some combination of these (Saunders, Lewis, & Thornhill, 2019). An overview of these research designs is given as follows: Exploratory studies allow researchers to ask open questions in order to discover what is happening and obtain insights in a topic of interest (Saunders, Lewis, Thornhill & Bristow, 2019). Exploratory designs are synonymous in qualitative data collection studies. Sue and Ritter (2012) state that descriptive research designs describe situations, products or people and usually have one guiding research question.

Explanatory research designs help to explain why the phenomena occur and predict future occurrences. Sue and Ritter (2012) assert that explanatory research use hypotheses to specify the nature and direction of relationships between variables investigated. The research designs are informed by specific research strategies. For example, experimental design is to study the probability of change in an independent variable causing change in another dependent variable. Hypotheses are used instead of research questions (Saunders et al., 2019). Bryman (2012) posits that cross-sectional designs entail collection of data on more than one case and a single point in time in order to quantify the data in connection with two or more variables to determine patterns of association.

When studies have repeated measurements over time or one or more groups of subjects, longitudinal designs are preferred (Deschenes, 1990). Thus, longitudinal designs allow researchers to follow a single group of people over the period of time and data related to the characteristics under investigation is collected at various points. In this study, an exploratory survey was the best option, because the sample size of participants were almost 2000 employees spread across various locations in SA. The survey allowed the researcher to pose questions to all participants in order to discover and obtain insights that could answer the research question.

3.4 Methodological Choice

Rassel, Leland, Mohr and O'Sullivan (2020) define research methodology as a structured set of steps and procedures for completing a research project. Saunders, Lewis, and Thornhill (2019) define research methodology as the theory of how research should be undertaken and research methods as the techniques or procedures used to obtain and analyse data. These could

include questionnaires, observation and interviews as well as both quantitative (statistical) and qualitative (non-statistical) analysis techniques (Saunders, Lewis, & Thornhill, 2019). There is a clear difference between research methods which equates to research tools and research methodology which is the general approach the researcher takes to carrying out a research project (Leedy & Ormond, 2016). Iyamu (2018) in Myers (2019) states that qualitative research describes the processes taken by a researcher in studying a phenomenon in their natural real-world settings. Researchers study participants' meanings and the relationship between them using a variety of data collection techniques and analytical procedures to develop a conceptual framework and theoretical contribution (Saunders et al., 2019).

O'Sullivan, Rassel, Berner and DeVance Taliaferro (2017) define quantitative research as research in which values of variables are characterised by numbers and data are summarized and analysed with statistical techniques. Quantitative research is associated with deductive research strategies where data is collected and analysed to test what is already known theory, however it may also incorporate an inductive approach where data is used to develop theory or uncover themes (Saunders et al., 2019).

Given the philosophical stance of this study, a quantitative research approach was adopted. The motivation being that a descriptive quantitative design provided systematic information regarding the factors affecting technology adoption of IoT. The researcher therefore, did not begin with a hypothesis, but rather endeavoured to first collect and analyse the data, then developed a hypothesis thereafter.

3.5 Target Population

Target population defines those units for which the findings of the study are meant to generalise (Lavrakas, 2008). It is made up of all the people or objects to which the study wishes to generalise the study findings. Saunders, et al., (2019) further define it as the complete set of cases or group members that is the actual focus of the research inquiry, and from which a sample may be drawn. With reference to the research design and statistical analysis, a population is the entire collection of entities one seeks to understand more formally, or draw an inference (Salkind, 2010).

For the study, the target population was comprised of employees from the clothing retailer, with a focus on employees working in the stores using the IoT technology, that had been introduced by the clothing retailer. This included contract and permanent staff that were in the roles of store assistants and store managers, with varying ages and length of service. The total number of target population elements was 297 people, therefore, it was large enough to draw a representative sample as each participant represented a store. Therfore 297 responses were collected from 2000 branches. These individuals possessed the requisite answers for the problem under investigation.

3.6 Sampling

Bryman (2012) defines a sample as a segment of the population that is selected for research. It is a subset of the population, and this method of selection may be based on probability sampling or non-probability sampling principles. Given the size of the target population was 2000 branches, it became imperative that a representative sample was required for the survey.

There exist two types of sampling strategies namely: probability or representative sampling and non-probability sampling. Babbie (2010) defines it as a technique where samples are selected in accordance with probability theory and typically involves some random-selection mechanism. Probability sampling is defined as a technique where the researcher selects a large number of individuals who are representative of the population or who represent a segment of the population (Creswell & Plano Clark, 2017). The most common probability sampling techniques are simple random where each sample element has an equal chance and known probability of being selected for the study (Hesse-Biber, 2010). With reference to stratified sampling, sample elements are divided into desired groups and then randomly selected until a target sample size has been reached. Another probability sampling technique is cluster sampling where all population elements are categorised into mutually exclusive and exhaustive groups/clusters and then clusters are selected for sampling (Frey, 2018). Systematic random sampling entails k^{th} unit in the list is selected for inclusion in the sample (Babbie, 2010). Sample units are selected at intervals from the sample frame.

Non-probability sampling is any technique in which samples are selected in some way not by probability theory (Babbie, 2010). The different non-probability sampling techniques include purposive where units are selected on the basis of the researcher's judgement about which ones will be most useful (Babbie, 2010). Convenience sampling is adopted when the sample elements are readily available and accessible at the time of conducting the study. As with

purposive sampling, the researcher uses personal judgment as to who to include or exclude in the study. Sample elements are included if they possess relevant data for the study. Snow-ball sampling is applied in field research where each person interviewed may be asked to suggest an additional person for interviewing.

In this study, the researcher used a probability sampling strategy. Simple random sampling was used in the survey with the objective of inclusion and ensuring that a representative sample was selected. The study involved target population elements from various branches of the clothing retailer in Cape Town, therefore, it was ideal to use the survey within the auspices of simple random sampling.

3.6.1 Sample size

Sample size usually refers to the number of units that were chosen from gathered data (Lavrakas, Research Design, 2008). When using a sample size, one should take into consideration sampling bias which O'Sullivan, et al., (2017) defines as a systematic misrepresentation of the population by the sample.

$$\text{Sample size} = \frac{\frac{z^2 \times p\,(1-p)}{e^2}}{1 + \left(\frac{z^2 \times p\,(1-p)}{e^2 N}\right)}$$

N = population size

e = margin of error

z^2 = z-score

p = population proportion

$$sample\ size = \frac{\frac{1.96^2 \times 0.1\ \times (1-0.1)}{0.05^2}}{1 + \frac{1.96^2 \times\ 0.1\ \times (1-0.1)}{0.05^2 \times 2000}}$$

$$sample\ size = \ 129$$

Using the formula above with a margin of error of 5% and a confidence level of 95% and a population proportion of 10% with a population of 2000, the sample size of the study was determined to be 129 respondents. To accommodate the likelihood of respondents not returning

the questionnaires, an additional 15% to the sample was added which brought the total sample size to 148. Questionnaires were sent out to all 2000 branches and 297 respondents completed the questionnaires. Which therefore constitutes a very good sample population size.

3.7 Research Methods

Data Collection and Data Analysis are the two components of the inner-most layer of the Saunders onion and the last step in developing the design. This layer is concerned with the procedure in which the data is gathered, collected and analysed. It furthermore explains the source of the data, sample, sample size, ethical considerations, and limitations of the study (Al Zefeiti & Azmi Mohamad, 2015). The basic idea of data collection in any research study is to gather information to address the questions being asked in the study (Creswell & Plano Clark, 2011). Data collection is the process of gathering and measuring information on variables of interest, in an established systematic fashion that enables one to answer stated research questions, test hypotheses, and evaluate outcomes (Krishnamurthi, Cabera, Karlovsky (2003) It consists of multiple interconnected steps: sampling, gaining permission and recruiting participants, identifying data sources, recording the data, and administering the data collection procedures (Creswell & Plano Clark, 2011). Teddlie and Yu (2007) state that the purpose of data collection in mixed methods study is to develop answers to the research questions.

In this study, quantitative data was collected from respondents through an online administered survey. A questionnaire with close-ended questions was designed (See Appendix A). The first section of the question was an introduction and purpose of the study. This was addressed to the respondents. In the demographics section, the focus was to elicit as much demographic information as possible. Respondents were requested to indicate their gender, age, areas they worked in, number of years working in logistics. In section B, the questionnaire focused on effects of IoT technology on supply chain processes. The impediments to the use of IoT was covered in section B.2. The interventions that might be adopted to improve IoT adoption were covered in section B.3. The questionnaire was designed in a Five-point Type Likert Scale. Respondents had options to choose one answer that resonated with their opinions. In the last section, B.4, respondents were requested to make additional comments. The focus was on Radio Frequency Identification Technology (RFID) as part of IoT, and what factors may have impacted adoption thereof.

3.8 Data Analysis

Data analysis refers to the processes associated with deriving meaning and understanding from the various data sets that may be collected during a research project as a basis for further action and theory building (Coghlan & Brydon-Miller, 2014). Babbie (2010) defines quantitative analysis as the numerical representation and manipulation of observations for the purpose of describing and explaining the phenomena that those observations reflect. Quantitative data was therefore collected and analysed for this study to describe and explain what the survey data inferred.

3.8.1 Statistical Data Analysis

Data gathered through the questionnaires was exported into Excel spreadsheets for cleaning and coding. Thereafter, the researcher computed data to provide measures of frequency; measures of central tendency, allowing the researcher to measure the spread of data (dispersion), variances and standard deviation, using SPSS v 25. These measures include the mean, median, mode, range, upper and lower quartiles. The results were presented in matrices and bar graphs. Leedy and Omrod (2014) state that descriptive statistics are used by researchers to provide basic descriptions of data features in the study. The researcher provided simple summaries about the sample and measures. Descriptive statistics were conducted to analyse reliability tests and regression analysis for evaluating mediating effects and hypotheses. In addition, descriptive statistics were used to clarify the sample's characteristics and more importantly, to evaluate the conceptual model. The researcher used Pearson correlation and multiple linear regression to analyse the significance, direction and strength of the relationships between variables.

3.9 Reliability and Validity

3.9.1 Reliability

Reliability refers to "a matter of whether a particular technique, applied repeatedly to the same object, yields the same result each time" (Babbie, 2014:152), and validity refers to "the correctness and truthfulness of an inference that is made from the results of a research study" (Christensen, Johnson & Turner, 2014:159). Some scholars argue that in the natural sciences many properties of objects can be measured with near-perfect reliability, in the social sciences the vast majority of measures yield scores that are, to some degree, unreliable. It is rather important to raise such arguments to appreciate the views of other scholars. Reliability is the property of an instrument that produces consistent scores every time it is used to measure a

constant value (Bless, Higson-Smith & Kagee, 2009). The greater the consistency and stability in an instrument, the more reliable it is (Kumar, 2012). In contrast, an instrument that always gives the same answer every time it is used to measure an unchanging value is highly reliable and can be trusted to provide accurate results (Bless, Higson-Smith & Kagee, 2009).

The internal consistency of the questionnaire in the study was assessed. Internal consistency is a factor that rates the degree to which diverse items are related. The researcher measured internal consistency reliability with Cronbach's coefficient alpha (Cronbach, 1951), using the self-administered questionnaire comprising mostly of 5-point Likert (1932) Scale questions ranging from 'strongly disagree' (1) to 'strongly agree' (5). However, the researcher was able to ensure that the respondents understood questions in order to provide reliable answers. The researcher also conducted a pilot study using non-probability purposive sampling to ascertain how the questions were understood by the respondents.

3.9.2 Validity

According to Onwuegbuzie and Leech (2006), it is critical to ensure validity for both a quantitative and a qualitative study. According to Zachariadis, Scott & Barrett (2013:5), design validity broadly refers to internal validity (that the correlation observed is causation) and external validity (results can be generalized). Validity implies the extent to which the researcher measures what is set out to be measured in the research questions and/or objectives. The internal validity refers to the actual events that are manifestations of the particular generative mechanism in the context of the field. Internal validity is "about how researchers infer that a relationship between two variables is causal" (Cook & Campbell, 1979:37).

The researcher selected the survey as the respondents were physically located across south Africa in the stores. Enough time was also allowed for the respondents to complete the survey, as they had to do this during working hours. The respondents were also advised that they will remain anonymous and that they were not obligated to participate or answer all or any of the questions. The researcher then looked for measures of central tendency in the survey responses to identify the most common responses to the questions. This would then describe or give an indication of the collective opinion of the respondents. There was no "normalised set of data" that the research was compared to, as it was a descriptive type of research.

3.10 Ethical considerations

There were various ethical issues considered before this study commenced. The first was to get approval from the Department of Information Systems. Once approval was granted, the researcher applied for ethical approval from Humanities and Social Sciences Research Ethics Committee (HSSREC) which was granted in October 2021 (See attached Appendix C). This was followed by gatekeeper's approval (See Appendix D) and then the data collection process commenced. Respondents and participants were informed about the purpose and goals of the study before their involvement in the study.

Each participant and/or respondent was politely asked to grant consent in writing or verbally as a true record that their participation in the study was voluntary. This was an important step to mitigate coercion or force participants and respondents against their will. All sensitive questions were teased out during the pilot study. This study ensured that all identifiable information was removed to protect the privacy and confidentiality of participants. The researcher's responsibility is to safeguard participants, build a sense of trust, foster honesty, and avoid misconduct and impropriety (Saunders, Lewis & Thornhill, 2012). The researcher reassured integrity, respect for people's rights and dignity, privacy for the participants, and that the participation was entirely voluntary, and could withdraw from the survey at any time without penalties.

The study did not examine sensitive or contentious issues that could have potentially caused harm to the participants. This study was not prejudicial to participants nor encroached on the rights of third parties. The study did not target children; persons living with disabilities; vulnerable women; vulnerable elderly communities; vulnerable communities; persons that might have found it difficult to make independent and informed decisions for social, economic, cultural, political and/or medical reasons; nor plants; animals or any environmentally sensitive research. The researcher did not collect, use or disclose any information without the consent of the individual or institution that is in possession of the required information. The study did not include any activities that might have placed the researcher or participants at risk.

3.11 Chapter summary

In conclusion, this chapter outlined the research plan adopted to the study. The researcher highlighted the case study design and that the pragmatic research paradigm informed the study,

resulting in the application of quantitative research. The presentation showed that applying this research methodology enhanced the reliability and validity of the research findings. A descriptive research design was adopted for this study because the researcher collected quantitative data. Quantitative data was exported to SPSS for statistical computations. Results were presented in matrices and bar graphs. In order to ensure the findings were valid, credible, and reliable, the researcher undertook and administered some processes and procedures and provided a detailed report of the research process. When conducting research, it was imperative to consider relevant ethical issues as has been explained in this study. In the next chapter, the results are presented, interpreted and discussed.

CHAPTER FOUR: DATA ANALYSIS RESULTS AND INTERPRETATION

4.1 Introduction

This chapter presents the results, analysis, and interpretation of the study. What follows is a general analysis of the location and demographic data of the participants. Thereafter, a detailed quantitative analysis of the participants responses is presented. Finally, study findings are described in detail, together with their implications. It is important to note at this stage that the head office of the retailer is in Parow in the Western Cape, but the surveys were completed by staff working in the stores located in various locations in SA, as can be seen if Figure 4.3.1 below.

4.2 The location of the study

The research was conducted at a large fashion retailer with its head office in Parow, Cape Town. The retailer has a portfolio of 18 retail brands in Africa that include clothing, footwear, jewellery, sportswear, mobile phones, technology products and furniture stores. The retailer had previously embarked on a journey of IoT technology adoption back in 2019 at around the same time that the global COVID-19 pandemic hit SA as well. The emergence of the COVID-19 pandemic impacted the retailer's supply chain business processes, and e slowed down the then planned rollout of the RFID technology. During the period of hard lock down, the retailer rolled out the technology and adopted the new processes in the branches to receive and count stock. This entailed replacing the barcode tags with RFID tags that mark consignments of stock in bulk to be scanned by the corresponding RFID scanners. The staff in the branches no longer physically scan each item of stock individually, but can now scan closed boxes of stock and stock on the shelves in the store as long as it was in range of the scanner. The retailer has 2 prototypes of conveyor belts moving boxes from delivery trucks to fixed scanners for bulk receiving of stock. The technology works well and promises to streamline supply chain processes, but it is still in the prototype phase and could not be included at that time in this study. The impact of IoT technology was therefore, limited only to acceptance of stock and stock takes/refills in the branches. The survey questions were therefore asked of staff that perform those functions in the branches.

4.3 The online survey and the sample population

The online survey was compiled using the questionnaire forms provided to the business. The survey was conducted internally by the organization, by means of their own communication

channel from head office to the brick and mortar branches/stores. Again. although the research was conducted at their head office in Parow in the Western Cape, the respondents were physically located in the branches across South Africa. See fig 4.3.1 below. The blue dots on the map in fig 4.3.1 indicate the location of the branches where the respondents completed the surveys.

The organisation has more than 2000 brick and mortar stores across Africa, but most are located in South Africa. The organization furthermore has about 10 brands in the group that sell various clothing and apparel, of which 2 were used in this study. These brands will be referred to as MK and RJ. MK is one of the group's oldest, more established brands selling casual and formal men's clothing, apparel and attire. RJ is a more recently formed brand catering mainly for casual men's clothing.

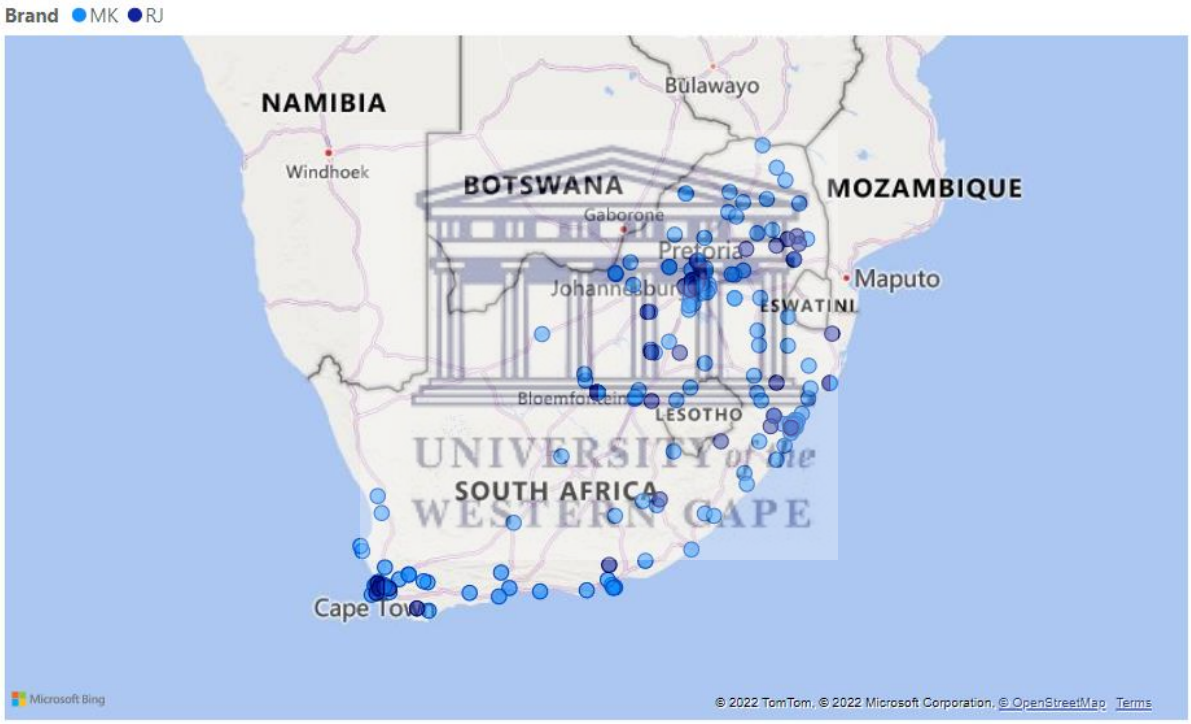


Fig 4.3.1 Location of the stores where respondents took the survey

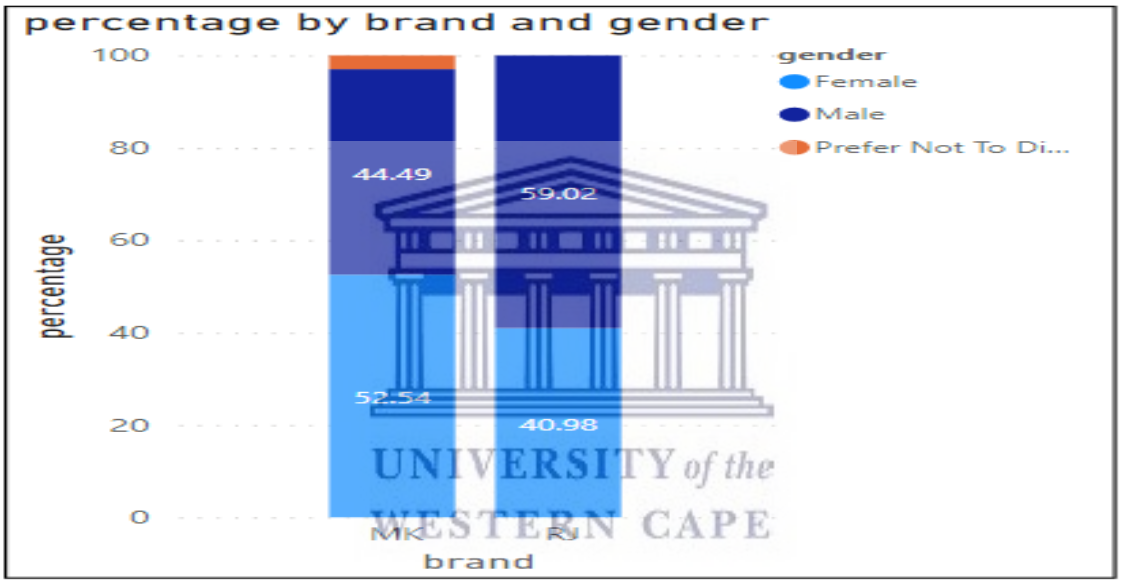
The online survey was distributed to 360 MK and about 180 RJ stores in the group of which 236 and 61 respectively responded. The response rate is therefore about 297 out of 2000, which is about 14.85%. This makes for a good sample population.

4.4 Section A: Demographics

The researcher used the raw data collected from the responses from the survey questions in the Likert format, as a dataset input to create the visualisations that follow below. Microsoft Power

BI was used to help with the computations. The visuals to some degree format automatically to auto-size and therefore in some cases, when a percentage on the bar graph is too small for a numerical character to fit into, then it omits that percentage from the visual. An example of this would be the missing percentage numeric for the 'Prefer to not disclose' category on the MK brand. Although the percentage is omitted from the bar graph, it can still be seen in the corresponding dataset/table where it indicates a percentage of 2.97% with a respondent count of 7 out of 297.

There was a 44% male and 53% female split in the gender of the respondents in the MK stores. The RJ stores in comparison have a corresponding 59% male and 41% female split. There is no significant gender imbalance (relative to this study) between the respondents, and the gender of the respondents will therefore not be a focus of the data analysis in this study.



brand	gender	percentage	total
MK	Female	52.54	124
MK	Male	44.49	105
MK	Prefer Not To Disclose	2.97	7
RJ	Female	40.98	25
RJ	Male	59.02	36
Total			**297**

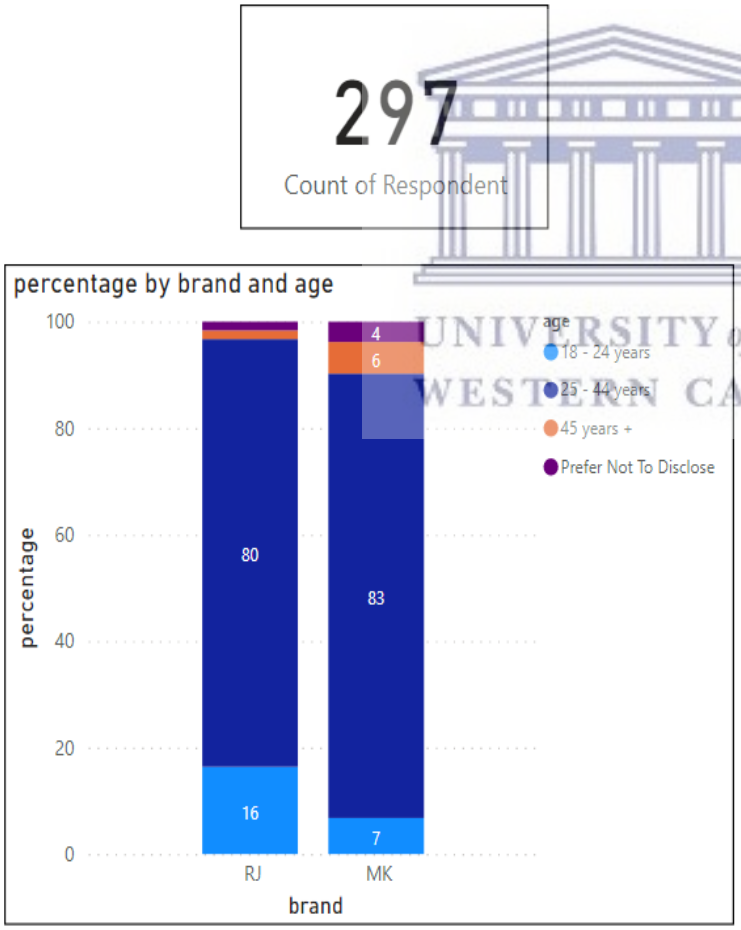
Fig 4.4.1 Gender split between MK and RJ brands

The average ages of most of the respondents are 25 to 44 years old – this amounts to about 80% of the total sample population. In MK 7% of the respondents are 18 to 24 years old where 16% of respondents s fall in this category for RJ. These age categories, as well as those in the 45 years and older category are therefore minorities in both brands.

Further analysis of the respondents in the 25 to 44 years old category shows that in MK, about 34% have between 1-5 years' experience in a retail environment, 28% have 6-10 years' experience, and 16% have 11-20 years' experience. Therefore, for MK, 78% of respondents in the 25 to 44 years old category have significant experience in retail.

Corresponding analysis of the RJ respondents in the 25 to 44 years old category shows that about 39% have between 1-5 years' experience in a retail environment, 26% have 6-10 years' experience, and 8% have 11-20 years' experience. Therefore, for RJ, 73% of respondents in the 25 to 44 years old category have significant experience in retail.

The demographic, age, and experience cross section are therefore very similar between employees allocated to the MK and RJ brands. There were no any significant responses from any of the survey questions to indicate that the respondent's age, or years of experience in retail, was a factor influencing adoption of IoT technology in the organisation. Age and years of retail experience too, will therefore not be a focus of the data analysis.



brand	age	experience	percentage	total
MK	18 - 24 years	> 1 year	1.69	4
MK	18 - 24 years	1 - 5 years	4.66	11
MK	18 - 24 years	6 - 10 years	0.42	1
MK	25 - 44 years	> 1 year	4.24	10
MK	25 - 44 years	1 - 5 years	34.32	81
MK	25 - 44 years	11 -20 years	16.10	38
MK	25 - 44 years	21 years +	1.27	3
MK	25 - 44 years	6 - 10 years	27.54	65
MK	45 years +	1 - 5 years	0.42	1
MK	45 years +	11 -20 years	3.39	8
MK	45 years +	21 years +	1.27	3
MK	45 years +	6 - 10 years	0.85	2
MK	Prefer Not To Disclose	> 1 year	0.42	1
MK	Prefer Not To Disclose	1 - 5 years	0.85	2
MK	Prefer Not To Disclose	11 -20 years	1.27	3
MK	Prefer Not To Disclose	21 years +	0.42	1
MK	Prefer Not To Disclose	6 - 10 years	0.85	2
RJ	18 - 24 years	> 1 year	1.64	1
RJ	18 - 24 years	1 - 5 years	13.11	8
RJ	18 - 24 years	6 - 10 years	1.64	1
RJ	25 - 44 years	> 1 year	6.56	4
RJ	25 - 44 years	1 - 5 years	39.34	24
RJ	25 - 44 years	11 -20 years	8.20	5
RJ	25 - 44 years	6 - 10 years	26.23	16
RJ	45 years +	11 -20 years	1.64	1
RJ	Prefer Not To Disclose	6 - 10 years	1.64	1

Fig 4.4.2 Demographic, age, and experience cross section of MK and RJ brands

4.5 Data Analysis

Analysis of the responses to the survey questions

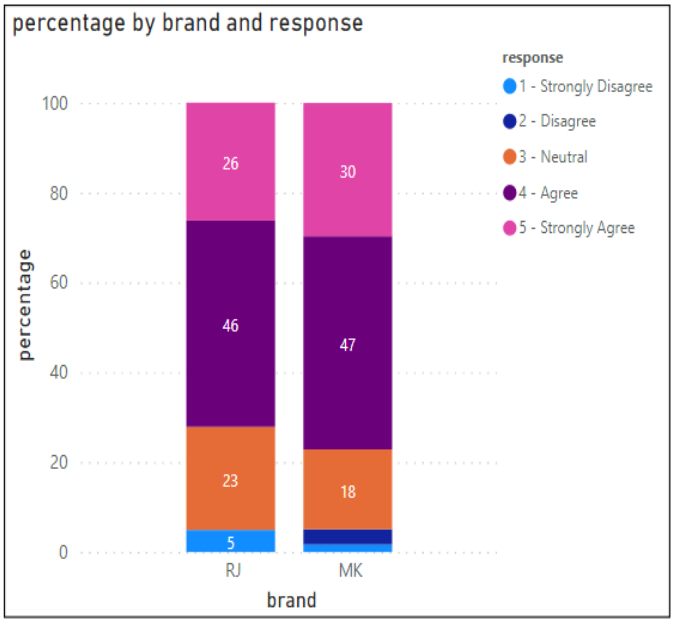
Data analysis technique: The researcher used a descriptive statistical method or *measure of frequency* to indicate how often a response in a given category occurs - 1 Strongly Disagree, 2 Disagree, 3 Neutral, 4 Agree, 5 Strongly Agree. The percentage of responses per category were therefore the main focus of analysis. Categories with the highest percentages per question would then generally be an indication of the sentiment of the group, whether they agree, neutral, or disagreement with the assertion of the question.

Section B.1: Effects of RFID technology on supply chain processes

B1. Q1: RFID tagging was easy to transition to from the previous bar-coding system

There were 72% of respondents in RJ that agreed, compared to 77% in MK. There were 23% neutral responses in RJ compared to 18% in MK. Given the results, 5% more respondents agreed in MK compared to RJ. The overall results indicate that the majority of respondents agreed it was easy to transition from the cardboard barcode tagging system to RFID tagging and scanning.

The users' willingness to adopt, and transition to the new IoT technology indicates that in the area of the business where the respondents work, they have a positive view of the IoT technology, and perhaps a belief that the new technologies will increase control, flexibility and efficiency as per Parasuraman (2000). This is indicative of, and in keeping with user characteristics in the *Optimism* dimension of the TRAM model (Parasuraman, 2000) and therefore a good indicator of the users' readiness to accept and adopt the new technology.



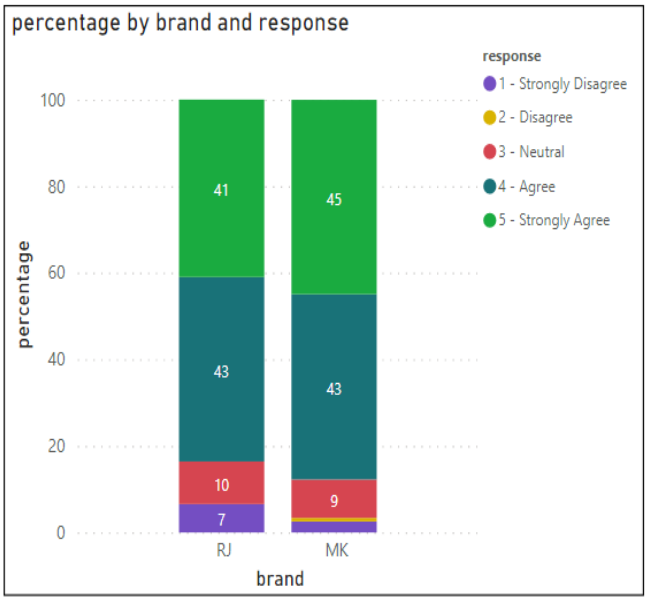
brand	age	experience	percentage	total	response
MK	25 - 44 years	1 - 5 years	18.22	43	4 - Agree
RJ	25 - 44 years	1 - 5 years	18.03	11	4 - Agree
RJ	25 - 44 years	6 - 10 years	16.39	10	4 - Agree
MK	25 - 44 years	6 - 10 years	13.98	33	4 - Agree
RJ	25 - 44 years	1 - 5 years	9.84	6	3 - Neutral
RJ	25 - 44 years	1 - 5 years	8.20	5	5 - Strongly Agree
MK	25 - 44 years	1 - 5 years	8.05	19	5 - Strongly Agree
MK	25 - 44 years	11 -20 years	8.05	19	5 - Strongly Agree
MK	25 - 44 years	1 - 5 years	6.78	16	3 - Neutral
RJ	25 - 44 years	11 -20 years	6.56	4	5 - Strongly Agree
MK	25 - 44 years	11 -20 years	6.36	15	4 - Agree
MK	25 - 44 years	6 - 10 years	6.36	15	5 - Strongly Agree
RJ	18 - 24 years	1 - 5 years	4.92	3	3 - Neutral
RJ	18 - 24 years	1 - 5 years	4.92	3	4 - Agree
RJ	25 - 44 years	> 1 year	4.92	3	4 - Agree
RJ	25 - 44 years	6 - 10 years	4.92	3	5 - Strongly Agree
MK	25 - 44 years	6 - 10 years	4.66	11	3 - Neutral
RJ	18 - 24 years	1 - 5 years	3.28	2	5 - Strongly Agree
RJ	25 - 44 years	1 - 5 years	3.28	2	1 - Strongly Disagree
RJ	25 - 44 years	6 - 10 years	3.28	2	3 - Neutral
MK	25 - 44 years	> 1 year	2.97	7	4 - Agree
MK	18 - 24 years	1 - 5 years	1.69	4	4 - Agree
MK	18 - 24 years	1 - 5 years	1.69	4	5 - Strongly Agree
MK	25 - 44 years	11 -20 years	1.69	4	3 - Neutral
MK	25 - 44 years	6 - 10 years	1.69	4	1 - Strongly Disagree
MK	45 years +	11 -20 years	1.69	4	3 - Neutral
RJ	18 - 24 years	> 1 year	1.64	1	5 - Strongly Agree
RJ	18 - 24 years	6 - 10 years	1.64	1	5 - Strongly Agree

Fig 4.5.1 - Q1: RFID tagging was easy to transition to from the previous bar-coding system

B1. Q2: RFID tagging has improved the process of locating stock in the stores

There were 84% of respondents in RJ that agreed, compared to 88% in MK. There were 10% neutral responses in RJ compared to 9% in MK. Given the results, 4% more respondents agreed in MK compared to RJ. The overall results indicate that the majority of respondents agreed that RFID tagging has improved the process of locating stock in the stores.

As stated in the Digiteum report (Digiteum, 2019) real-time asset tracking was marked for consideration as an area of business value creation. The report states that IoT technology enables more accurate tracking of stock in SCM (Digiteum, 2019). Here it can be seen that this is indeed the case.



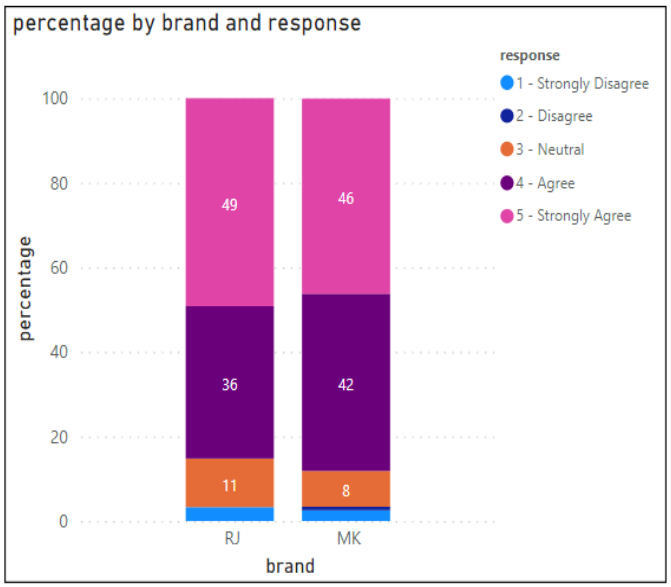
brand	age	experience	percentage	total	response
MK	25 - 44 years	1 - 5 years	15.68	37	5 - Strongly Agree
MK	25 - 44 years	1 - 5 years	14.83	35	4 - Agree
RJ	25 - 44 years	1 - 5 years	14.75	9	4 - Agree
RJ	25 - 44 years	1 - 5 years	14.75	9	5 - Strongly Agree
MK	25 - 44 years	6 - 10 years	13.56	32	4 - Agree
RJ	25 - 44 years	6 - 10 years	13.11	8	4 - Agree
MK	25 - 44 years	6 - 10 years	11.86	28	5 - Strongly Agree
MK	25 - 44 years	11 -20 years	10.17	24	5 - Strongly Agree
RJ	18 - 24 years	1 - 5 years	9.84	6	5 - Strongly Agree
RJ	25 - 44 years	6 - 10 years	9.84	6	5 - Strongly Agree
RJ	25 - 44 years	1 - 5 years	6.56	4	3 - Neutral
RJ	25 - 44 years	> 1 year	4.92	3	4 - Agree
MK	25 - 44 years	11 -20 years	4.66	11	4 - Agree
MK	25 - 44 years	1 - 5 years	3.39	8	3 - Neutral
RJ	18 - 24 years	1 - 5 years	3.28	2	4 - Agree
RJ	25 - 44 years	1 - 5 years	3.28	2	1 - Strongly Disagree
RJ	25 - 44 years	11 -20 years	3.28	2	4 - Agree
RJ	25 - 44 years	11 -20 years	3.28	2	5 - Strongly Agree
RJ	25 - 44 years	6 - 10 years	3.28	2	1 - Strongly Disagree
MK	18 - 24 years	1 - 5 years	2.97	7	4 - Agree
MK	25 - 44 years	> 1 year	2.54	6	5 - Strongly Agree
MK	25 - 44 years	> 1 year	1.69	4	4 - Agree
RJ	18 - 24 years	> 1 year	1.64	1	4 - Agree
RJ	18 - 24 years	6 - 10 years	1.64	1	5 - Strongly Agree
RJ	25 - 44 years	> 1 year	1.64	1	5 - Strongly Agree
RJ	25 - 44 years	11 -20 years	1.64	1	3 - Neutral
RJ	45 years +	11 -20 years	1.64	1	3 - Neutral
RJ	Prefer Not To Disclose	6 - 10 years	1.64	1	4 - Agree

Fig 4.5.2 – Q2: RFID tagging has improved the process of locating stock in the stores

B1. Q3: RFID tagging has improved the process of stocktaking and refilling

There were 85% of respondents in RJ that agreed, compared to 88% in MK. There were 11% neutral responses in RJ compared to 8% in MK. Given the results, 3% more respondents agreed in MK compared to RJ. The overall results indicate that the majority of respondents agreed that RFID tagging has improved the process of stocktaking and refilling stock in the stores.

As stated in the Digiteum report (Digiteum, 2019) real-time asset tracking was marked for consideration as an area of business value creation. The report states that IoT technology enables more accurate tracking of stock in SCM (Digiteum, 2019). It is revealed that RFID scanners are used to locate and count the stock therefore, it is creating a process improvement.



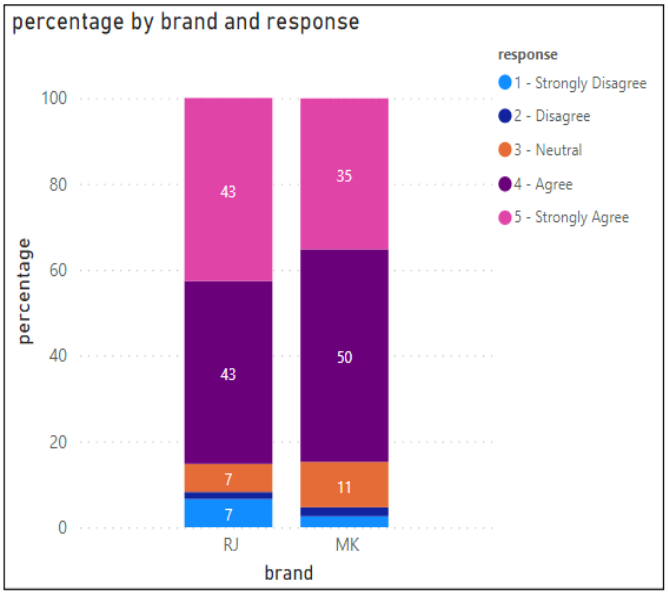
brand	age	experience	percentage	total	response
RJ	25 - 44 years	1 - 5 years	18.03	11	4 - Agree
MK	25 - 44 years	1 - 5 years	16.53	39	4 - Agree
RJ	25 - 44 years	6 - 10 years	16.39	10	5 - Strongly Agree
MK	25 - 44 years	1 - 5 years	14.41	34	5 - Strongly Agree
MK	25 - 44 years	6 - 10 years	13.56	32	4 - Agree
RJ	25 - 44 years	1 - 5 years	13.11	8	5 - Strongly Agree
MK	25 - 44 years	6 - 10 years	11.02	26	5 - Strongly Agree
MK	25 - 44 years	11 -20 years	10.59	25	5 - Strongly Agree
RJ	18 - 24 years	1 - 5 years	9.84	6	5 - Strongly Agree
RJ	25 - 44 years	6 - 10 years	8.20	5	4 - Agree
RJ	25 - 44 years	1 - 5 years	6.56	4	3 - Neutral
RJ	25 - 44 years	11 -20 years	4.92	3	5 - Strongly Agree
MK	25 - 44 years	11 -20 years	4.24	10	4 - Agree
RJ	18 - 24 years	1 - 5 years	3.28	2	4 - Agree
RJ	25 - 44 years	> 1 year	3.28	2	4 - Agree
RJ	25 - 44 years	> 1 year	3.28	2	5 - Strongly Agree
MK	25 - 44 years	> 1 year	2.54	6	4 - Agree
MK	25 - 44 years	1 - 5 years	2.54	6	3 - Neutral
MK	18 - 24 years	1 - 5 years	2.12	5	5 - Strongly Agree
MK	25 - 44 years	6 - 10 years	2.12	5	3 - Neutral
MK	18 - 24 years	1 - 5 years	1.69	4	4 - Agree
MK	25 - 44 years	> 1 year	1.69	4	5 - Strongly Agree
RJ	18 - 24 years	> 1 year	1.64	1	4 - Agree
RJ	18 - 24 years	6 - 10 years	1.64	1	5 - Strongly Agree
RJ	25 - 44 years	1 - 5 years	1.64	1	1 - Strongly Disagree
RJ	25 - 44 years	11 -20 years	1.64	1	3 - Neutral
RJ	25 - 44 years	11 -20 years	1.64	1	4 - Agree
RJ	25 - 44 years	6 - 10 years	1.64	1	1 - Strongly Disagree

Fig 4.5.3 – Q3: RFID tagging has improved the process of stocktaking and refilling

B1. Q4: RFID tagging has aided the staff to work more efficiently

There were 86% of respondents in RJ that agreed, compared to 85% in MK. There were 7% neutral responses in RJ compared to 11% in MK. Given the results, only 1% more respondents agreed in MK compared to RJ. The overall results indicate that the majority of respondents agreed that RFID tagging has aided them to work more efficiently.

The users' willingness to adopt, and transition to the new IoT technology indicates that in the area of the business where the respondents work, they have a positive view of the IoT technology, and a definite belief that the new technologies increase efficiency as per Parasuraman (2000). This is indicative of, and in keeping with user characteristics in the *Optimism* dimension of the TRAM model (Lin, Hsin-Yu, & Sher, 2007) and therefore a good indicator of the users' readiness to accept and adopt the new technology.



brand	age	experience	percentage	total	response
MK	25 - 44 years	1 - 5 years	19.92	47	4 - Agree
RJ	25 - 44 years	1 - 5 years	16.39	10	5 - Strongly Agree
RJ	25 - 44 years	6 - 10 years	14.75	9	4 - Agree
MK	25 - 44 years	6 - 10 years	13.98	33	4 - Agree
RJ	25 - 44 years	1 - 5 years	13.11	8	4 - Agree
MK	25 - 44 years	1 - 5 years	11.02	26	5 - Strongly Agree
MK	25 - 44 years	6 - 10 years	8.90	21	5 - Strongly Agree
RJ	18 - 24 years	1 - 5 years	8.20	5	5 - Strongly Agree
RJ	25 - 44 years	6 - 10 years	8.20	5	5 - Strongly Agree
MK	25 - 44 years	11 -20 years	8.05	19	5 - Strongly Agree
RJ	25 - 44 years	1 - 5 years	6.56	4	3 - Neutral
MK	25 - 44 years	11 -20 years	5.93	14	4 - Agree
RJ	18 - 24 years	1 - 5 years	4.92	3	4 - Agree
RJ	25 - 44 years	11 -20 years	4.92	3	5 - Strongly Agree
MK	25 - 44 years	6 - 10 years	3.39	8	3 - Neutral
RJ	25 - 44 years	> 1 year	3.28	2	4 - Agree
RJ	25 - 44 years	> 1 year	3.28	2	5 - Strongly Agree
RJ	25 - 44 years	1 - 5 years	3.28	2	1 - Strongly Disagree
RJ	25 - 44 years	11 -20 years	3.28	2	4 - Agree
RJ	25 - 44 years	6 - 10 years	3.28	2	1 - Strongly Disagree
MK	25 - 44 years	> 1 year	2.54	6	4 - Agree
MK	25 - 44 years	1 - 5 years	2.54	6	3 - Neutral
MK	18 - 24 years	1 - 5 years	1.69	4	4 - Agree
MK	18 - 24 years	1 - 5 years	1.69	4	5 - Strongly Agree
MK	25 - 44 years	> 1 year	1.69	4	5 - Strongly Agree
MK	25 - 44 years	11 -20 years	1.69	4	3 - Neutral
MK	45 years +	11 -20 years	1.69	4	4 - Agree
RJ	18 - 24 years	> 1 year	1.64	1	2 - Disagree

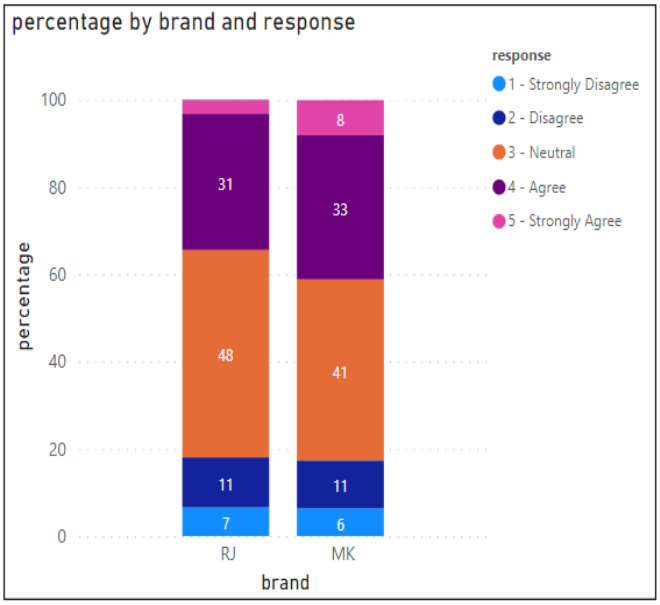
Fig 4.5.4 – Q4: RFID tagging has aided staff to work more efficiently

Section B.2: The impediments to the use of RFID technology on supply chain processes

B2. Q1: It is costly to implement RFID technologies

There were 34% of respondents in RJ that agreed, compared to 41% in MK. There were 48% neutral responses in RJ compared to 41% in MK. Given the results, 12% more respondents agreed in MK compared to RJ. The overall results indicate that many of the respondents are unsure whether it is costly to the organisation to implement RFID technologies.

This may be due to the fact that many of the responses in this section come from staff that are not privy to financial information of the organisation.



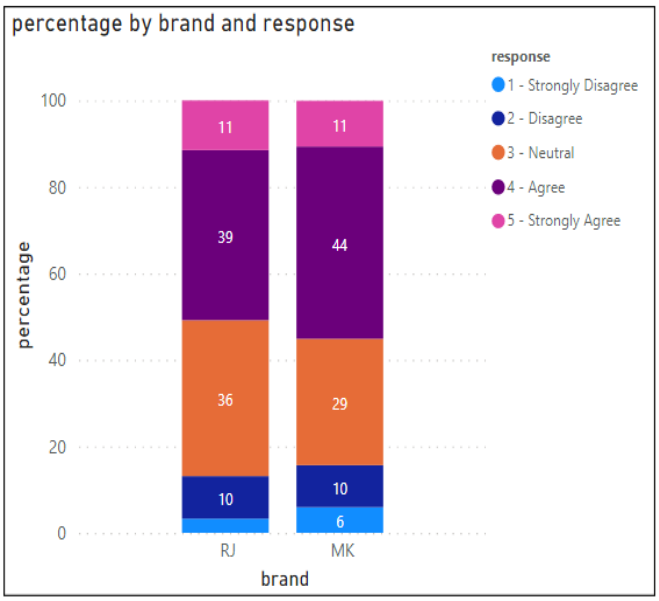
brand	age	experience	percentage	total	response
RJ	25 - 44 years	1 - 5 years	22.95	14	3 - Neutral
MK	25 - 44 years	1 - 5 years	14.41	34	3 - Neutral
RJ	25 - 44 years	1 - 5 years	13.11	8	4 - Agree
MK	25 - 44 years	1 - 5 years	11.86	28	4 - Agree
MK	25 - 44 years	6 - 10 years	11.86	28	3 - Neutral
RJ	25 - 44 years	6 - 10 years	9.84	6	3 - Neutral
MK	25 - 44 years	6 - 10 years	8.47	20	4 - Agree
RJ	25 - 44 years	6 - 10 years	8.20	5	4 - Agree
RJ	18 - 24 years	1 - 5 years	6.56	4	3 - Neutral
RJ	25 - 44 years	> 1 year	6.56	4	4 - Agree
MK	25 - 44 years	11 -20 years	5.93	14	3 - Neutral
MK	25 - 44 years	11 -20 years	5.93	14	4 - Agree
RJ	25 - 44 years	11 -20 years	4.92	3	3 - Neutral
RJ	25 - 44 years	6 - 10 years	4.92	3	2 - Disagree
MK	25 - 44 years	1 - 5 years	3.39	8	2 - Disagree
MK	25 - 44 years	6 - 10 years	3.39	8	2 - Disagree
RJ	18 - 24 years	1 - 5 years	3.28	2	1 - Strongly Disagree
RJ	25 - 44 years	1 - 5 years	3.28	2	2 - Disagree
RJ	25 - 44 years	6 - 10 years	3.28	2	1 - Strongly Disagree
MK	25 - 44 years	> 1 year	2.97	7	3 - Neutral
MK	25 - 44 years	1 - 5 years	2.54	6	1 - Strongly Disagree
MK	25 - 44 years	6 - 10 years	2.54	6	5 - Strongly Agree
MK	25 - 44 years	1 - 5 years	2.12	5	5 - Strongly Agree
MK	25 - 44 years	11 -20 years	2.12	5	5 - Strongly Agree
MK	18 - 24 years	1 - 5 years	1.69	4	3 - Neutral
MK	45 years +	11 -20 years	1.69	4	4 - Agree
RJ	18 - 24 years	> 1 year	1.64	1	3 - Neutral
RJ	18 - 24 years	1 - 5 years	1.64	1	4 - Agree

Fig 4.5.5 – Q1: It is costly to implement RFID technologies

B2. Q2: The level of computer literacy is very low among employees

There were 50% of respondents in RJ that agreed, compared to 55% in MK. There were 36% neutral responses in RJ compared to 29% in MK. Given the results, 5% more respondents agreed in MK compared to RJ. The overall results indicate that the majority of respondents agreed that the level of computer literacy is very low among employees.

The respondents seem to have adopted the technology quite easily, which is a further indication that the technology was easy to adopt and implement even though there was a generally low level of computer literacy. According to Parasuraman (2000) and Lin, Hsin-Yu, & Sher (2007) this is indicative of and in keeping with user characteristics in the *Optimism* dimension of the TRAM model and therefore a good indicator of the users' readiness to accept and adopt the new technology.



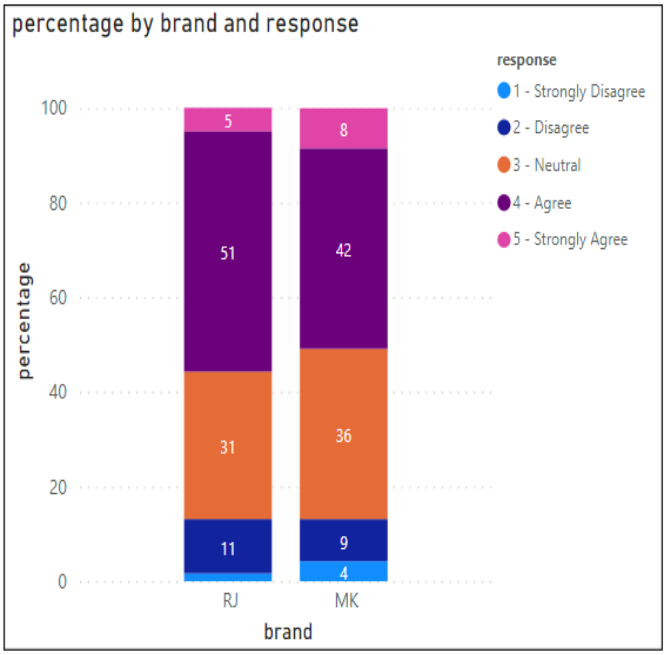
brand	age	experience	percentage	total	response
RJ	25 - 44 years	6 - 10 years	18.03	11	4 - Agree
RJ	25 - 44 years	1 - 5 years	16.39	10	3 - Neutral
MK	25 - 44 years	1 - 5 years	15.68	37	4 - Agree
RJ	25 - 44 years	1 - 5 years	11.48	7	4 - Agree
MK	25 - 44 years	6 - 10 years	10.59	25	4 - Agree
MK	25 - 44 years	6 - 10 years	10.17	24	3 - Neutral
MK	25 - 44 years	1 - 5 years	9.32	22	3 - Neutral
MK	25 - 44 years	11 -20 years	7.20	17	4 - Agree
RJ	18 - 24 years	1 - 5 years	6.56	4	3 - Neutral
RJ	25 - 44 years	1 - 5 years	6.56	4	2 - Disagree
RJ	18 - 24 years	1 - 5 years	4.92	3	5 - Strongly Agree
RJ	25 - 44 years	> 1 year	4.92	3	4 - Agree
RJ	25 - 44 years	1 - 5 years	4.92	3	5 - Strongly Agree
RJ	25 - 44 years	6 - 10 years	4.92	3	3 - Neutral
MK	25 - 44 years	1 - 5 years	4.24	10	2 - Disagree
MK	25 - 44 years	11 -20 years	4.24	10	3 - Neutral
MK	25 - 44 years	> 1 year	3.39	8	4 - Agree
RJ	25 - 44 years	11 -20 years	3.28	2	3 - Neutral
MK	25 - 44 years	1 - 5 years	2.97	7	1 - Strongly Disagree
MK	25 - 44 years	6 - 10 years	2.97	7	5 - Strongly Agree
MK	25 - 44 years	6 - 10 years	2.54	6	2 - Disagree
MK	25 - 44 years	1 - 5 years	2.12	5	5 - Strongly Agree
MK	25 - 44 years	11 -20 years	2.12	5	5 - Strongly Agree
MK	45 years +	11 -20 years	2.12	5	4 - Agree
MK	18 - 24 years	1 - 5 years	1.69	4	4 - Agree
MK	25 - 44 years	11 -20 years	1.69	4	2 - Disagree
RJ	18 - 24 years	> 1 year	1.64	1	4 - Agree
RJ	18 - 24 years	1 - 5 years	1.64	1	4 - Agree

Fig 4.5.6 – Q2: The level of computer literacy is very low among employees

B2. Q3: Fear of the unknown contributes to employees' resistance to change

There were 56% of respondents in RJ that agreed, compared to 50% in MK. There were 31% neutral responses in RJ compared to 36% in MK. Given the results, 6% more respondents agreed in MK compared to RJ. The overall results indicate that the majority of respondents agreed that fear of the unknown may contributed to employees' resistance to change.

The respondents seem to have adopted the technology quite easily, which is a further indication that the technology was easy to adopt and implement even though the staff may have had certain fears or misgivings. As pointed out by Parasuraman & Colby (2014) the users demonstrate behavioural characteristics of those described in the *Optimism* dimension of the TRAM model and therefore, it is a good indicator of the users' readiness to accept and adopt the new technology.



brand	age	experience	percentage	total	response
RJ	25 - 44 years	1 - 5 years	19.67	12	4 - Agree
RJ	25 - 44 years	1 - 5 years	16.39	10	3 - Neutral
RJ	25 - 44 years	6 - 10 years	14.75	9	4 - Agree
MK	25 - 44 years	1 - 5 years	14.41	34	4 - Agree
MK	25 - 44 years	6 - 10 years	13.98	33	4 - Agree
MK	25 - 44 years	1 - 5 years	11.86	28	3 - Neutral
MK	25 - 44 years	6 - 10 years	9.32	22	3 - Neutral
RJ	18 - 24 years	1 - 5 years	6.56	4	3 - Neutral
RJ	18 - 24 years	1 - 5 years	6.56	4	4 - Agree
MK	25 - 44 years	11 -20 years	6.36	15	4 - Agree
MK	25 - 44 years	11 -20 years	5.93	14	3 - Neutral
RJ	25 - 44 years	> 1 year	4.92	3	4 - Agree
RJ	25 - 44 years	6 - 10 years	4.92	3	2 - Disagree
RJ	25 - 44 years	6 - 10 years	4.92	3	3 - Neutral
MK	25 - 44 years	1 - 5 years	3.39	8	2 - Disagree
RJ	25 - 44 years	1 - 5 years	3.28	2	2 - Disagree
RJ	25 - 44 years	11 -20 years	3.28	2	3 - Neutral
RJ	25 - 44 years	11 -20 years	3.28	2	4 - Agree
MK	25 - 44 years	1 - 5 years	2.54	6	1 - Strongly Disagree
MK	18 - 24 years	1 - 5 years	2.12	5	3 - Neutral
MK	25 - 44 years	> 1 year	2.12	5	4 - Agree
MK	25 - 44 years	1 - 5 years	2.12	5	5 - Strongly Agree
MK	25 - 44 years	6 - 10 years	2.12	5	2 - Disagree
MK	25 - 44 years	11 -20 years	1.69	4	5 - Strongly Agree
MK	25 - 44 years	6 - 10 years	1.69	4	5 - Strongly Agree
MK	45 years +	11 -20 years	1.69	4	3 - Neutral
RJ	18 - 24 years	> 1 year	1.64	1	2 - Disagree
RJ	18 - 24 years	6 - 10 years	1.64	1	4 - Agree

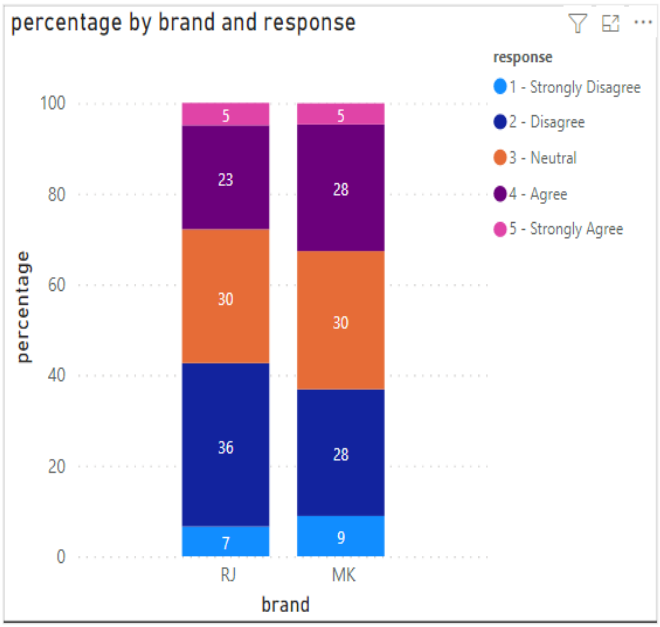
Fig 4.5.7 – Q3: Fear of the unknown contributes to employees' resistance to change

B2. Q4: There is a lack of understanding of how RFID technologies can improve efficiency

There were 28% of respondents in RJ that agreed, compared to 33% in MK. There were 30% neutral responses from both RJ and MK. Given the results, 5% more respondents agreed in MK compared to RJ. The overall results indicate that the majority of respondents agreed that there is a lack of understanding of how RFID technologies can improve efficiency.

The respondents adopted the technology quite easily, which is an indication that the technology was easy to adopt and implement even though the staff may have had a lack of understanding of how RFID technologies can improve efficiency.

This is moreover in keeping with behaviour of users' characteristics depicted in the Optimism dimension of the TRAM model (Lin, Hsin-Yu, & Sher, 2007) and therefore, a good indicator of the users' readiness to accept and adopt the new technology.



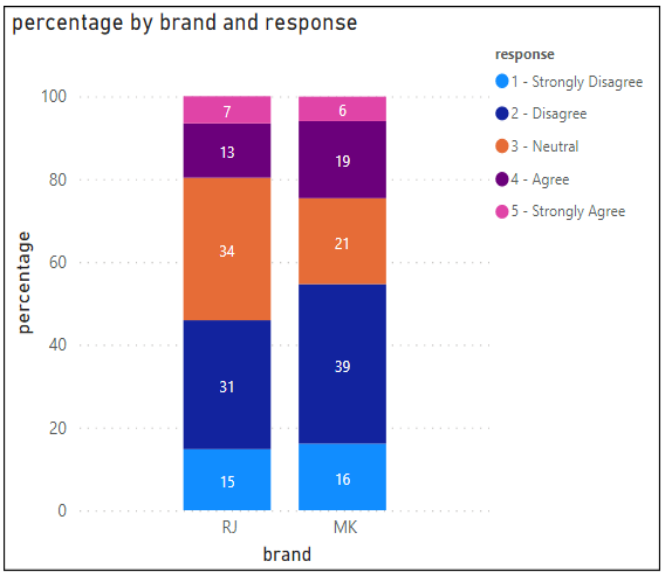
brand	age	experience	percentage	total	response
RJ	25 - 44 years	1 - 5 years	16.39	10	2 - Disagree
RJ	25 - 44 years	1 - 5 years	11.48	7	3 - Neutral
RJ	25 - 44 years	6 - 10 years	11.48	7	2 - Disagree
MK	25 - 44 years	1 - 5 years	10.17	24	2 - Disagree
MK	25 - 44 years	1 - 5 years	10.17	24	3 - Neutral
MK	25 - 44 years	1 - 5 years	10.17	24	4 - Agree
MK	25 - 44 years	6 - 10 years	9.32	22	2 - Disagree
RJ	25 - 44 years	1 - 5 years	8.20	5	4 - Agree
RJ	25 - 44 years	6 - 10 years	8.20	5	3 - Neutral
MK	25 - 44 years	6 - 10 years	7.63	18	4 - Agree
MK	25 - 44 years	6 - 10 years	7.20	17	3 - Neutral
RJ	18 - 24 years	1 - 5 years	6.56	4	3 - Neutral
MK	25 - 44 years	11 -20 years	5.08	12	3 - Neutral
MK	25 - 44 years	11 -20 years	4.24	10	4 - Agree
MK	25 - 44 years	11 -20 years	3.81	9	2 - Disagree
RJ	18 - 24 years	1 - 5 years	3.28	2	2 - Disagree
RJ	18 - 24 years	1 - 5 years	3.28	2	4 - Agree
RJ	25 - 44 years	> 1 year	3.28	2	4 - Agree
RJ	25 - 44 years	1 - 5 years	3.28	2	1 - Strongly Disagree
RJ	25 - 44 years	11 -20 years	3.28	2	4 - Agree
RJ	25 - 44 years	6 - 10 years	3.28	2	1 - Strongly Disagree
MK	25 - 44 years	1 - 5 years	2.97	7	1 - Strongly Disagree
MK	25 - 44 years	> 1 year	2.12	5	4 - Agree
MK	25 - 44 years	6 - 10 years	2.12	5	1 - Strongly Disagree
MK	18 - 24 years	1 - 5 years	1.69	4	3 - Neutral
MK	25 - 44 years	11 -20 years	1.69	4	5 - Strongly Agree
RJ	18 - 24 years	> 1 year	1.64	1	4 - Agree
RJ	18 - 24 years	6 - 10 years	1.64	1	5 - Strongly Agree

Fig 4.5.8 – Q4: There is a lack of understanding of how RFID technologies can improve efficiency

B2. Q5: Resistance to change from legacy systems to RFID is a huge problem among employees

There were 46% of respondents in RJ that disagreed, compared to 55% in MK. There were 34% neutral responses in RJ compared to 21% in MK. Given the results, 9% more respondents disagreed in MK compared to RJ. The overall results indicate that the majority of respondents disagreed that resistance to change from legacy systems to RFID is a huge problem among employees.

The users' willingness to adopt, and transition to the new IoT technology indicates that in the area of the business where the respondents work, they have a positive view of the IoT technology, and a belief that resistance to change from legacy systems to RFID is not a huge problem among employees. This again is in keeping with behaviour of users' characteristics depicted in the *Optimism* dimension of the TRAM model (Parasuraman & Colby, 2014) and therefore a good indicator of the users' readiness to accept and adopt the new technology.



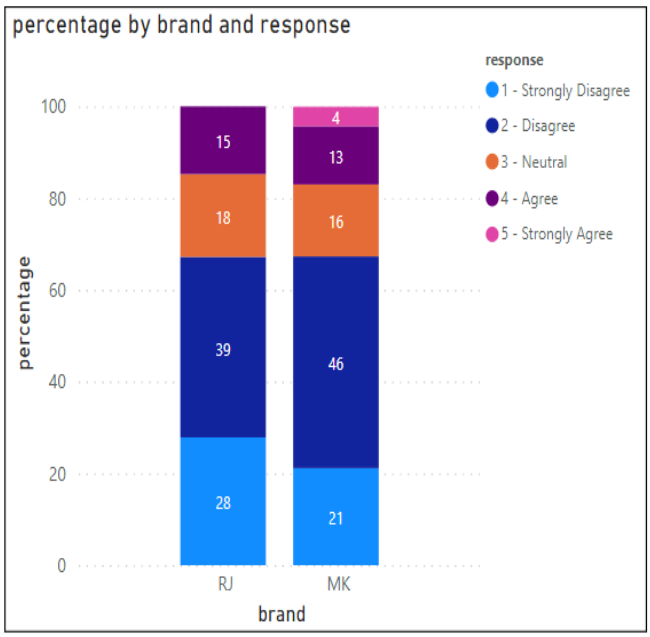
brand	age	experience	percentage	total	response
MK	18 - 24 years	> 1 year	0.42	1	5 - Strongly Agree
MK	18 - 24 years	> 1 year	1.27	3	2 - Disagree
MK	18 - 24 years	1 - 5 years	0.42	1	3 - Neutral
MK	18 - 24 years	1 - 5 years	0.85	2	4 - Agree
MK	18 - 24 years	1 - 5 years	1.27	3	2 - Disagree
MK	18 - 24 years	1 - 5 years	2.12	5	1 - Strongly Disagree
MK	18 - 24 years	6 - 10 years	0.42	1	4 - Agree
MK	25 - 44 years	> 1 year	0.42	1	1 - Strongly Disagree
MK	25 - 44 years	> 1 year	0.42	1	5 - Strongly Agree
MK	25 - 44 years	> 1 year	1.69	4	2 - Disagree
MK	25 - 44 years	> 1 year	1.69	4	4 - Agree
MK	25 - 44 years	1 - 5 years	2.54	6	5 - Strongly Agree
MK	25 - 44 years	1 - 5 years	5.08	12	1 - Strongly Disagree
MK	25 - 44 years	1 - 5 years	5.93	14	4 - Agree
MK	25 - 44 years	1 - 5 years	7.20	17	3 - Neutral
MK	25 - 44 years	1 - 5 years	13.56	32	2 - Disagree
MK	25 - 44 years	11 -20 years	0.85	2	5 - Strongly Agree
MK	25 - 44 years	11 -20 years	1.69	4	4 - Agree
MK	25 - 44 years	11 -20 years	2.54	6	1 - Strongly Disagree
MK	25 - 44 years	11 -20 years	5.08	12	3 - Neutral
MK	25 - 44 years	11 -20 years	5.93	14	2 - Disagree
MK	25 - 44 years	21 years +	0.42	1	5 - Strongly Agree
MK	25 - 44 years	21 years +	0.85	2	3 - Neutral
MK	25 - 44 years	6 - 10 years	4.24	10	1 - Strongly Disagree
MK	25 - 44 years	6 - 10 years	5.51	13	3 - Neutral
MK	25 - 44 years	6 - 10 years	6.36	15	4 - Agree
MK	25 - 44 years	6 - 10 years	11.44	27	2 - Disagree
MK	45 years +	1 - 5 years	0.42	1	5 - Strongly Agree

Fig 4.5.9 – Q5: Resistance to change from legacy systems to RFID is a huge problem among employees

B2. Q6: The idea of adopting RFID has not effectively been shared with employees

There were 67% of respondents in both RJ and MK that disagreed. There were 18% neutral responses in RJ compared to 16% in MK. The overall results indicate that the majority of respondents disagreed that the idea of adopting RFID has not effectively been shared with employees.

The respondents believe that management has clarified its strategic objective regarding the transition to RFID. This is most likely in part the reason for the successful adoption of the RFID technology. This is aligned with behaviour of users' characteristics depicted in the *Optimism* dimension of the TRAM model (Lin, Hsin-Yu, & Sher, 2007). This is a desirable element in technology adoption.



brand	age	experience	percentage	total	response
MK	25 - 44 years	1 - 5 years	19.07	45	2 - Disagree
RJ	25 - 44 years	1 - 5 years	14.75	9	2 - Disagree
RJ	25 - 44 years	6 - 10 years	14.75	9	1 - Strongly Disagree
MK	25 - 44 years	6 - 10 years	10.17	24	2 - Disagree
RJ	18 - 24 years	1 - 5 years	9.84	6	2 - Disagree
RJ	25 - 44 years	1 - 5 years	9.84	6	4 - Agree
RJ	25 - 44 years	1 - 5 years	8.20	5	3 - Neutral
MK	25 - 44 years	1 - 5 years	7.20	17	1 - Strongly Disagree
MK	25 - 44 years	11 -20 years	7.20	17	2 - Disagree
RJ	25 - 44 years	1 - 5 years	6.56	4	1 - Strongly Disagree
RJ	25 - 44 years	6 - 10 years	6.56	4	2 - Disagree
MK	25 - 44 years	6 - 10 years	6.36	15	1 - Strongly Disagree
MK	25 - 44 years	1 - 5 years	4.66	11	3 - Neutral
MK	25 - 44 years	6 - 10 years	4.66	11	4 - Agree
MK	25 - 44 years	6 - 10 years	4.24	10	3 - Neutral
MK	25 - 44 years	11 -20 years	3.81	9	1 - Strongly Disagree
MK	25 - 44 years	11 -20 years	3.39	8	3 - Neutral
RJ	25 - 44 years	> 1 year	3.28	2	1 - Strongly Disagree
RJ	25 - 44 years	11 -20 years	3.28	2	1 - Strongly Disagree
RJ	25 - 44 years	11 -20 years	3.28	2	2 - Disagree
RJ	25 - 44 years	6 - 10 years	3.28	2	3 - Neutral
MK	25 - 44 years	1 - 5 years	2.54	6	4 - Agree
MK	25 - 44 years	> 1 year	2.12	5	2 - Disagree
MK	25 - 44 years	6 - 10 years	2.12	5	5 - Strongly Agree
MK	18 - 24 years	1 - 5 years	1.69	4	1 - Strongly Disagree
MK	25 - 44 years	> 1 year	1.69	4	4 - Agree
MK	45 years +	11 -20 years	1.69	4	2 - Disagree
RJ	18 - 24 years	> 1 year	1.64	1	2 - Disagree

Fig 4.5.10 – Q6: The idea of adopting RFID has not effectively been shared with employees

B4. Q1: Is there anything else you would like to add to give insight into the issues relating to the transition and integration of RFID technology in your area?

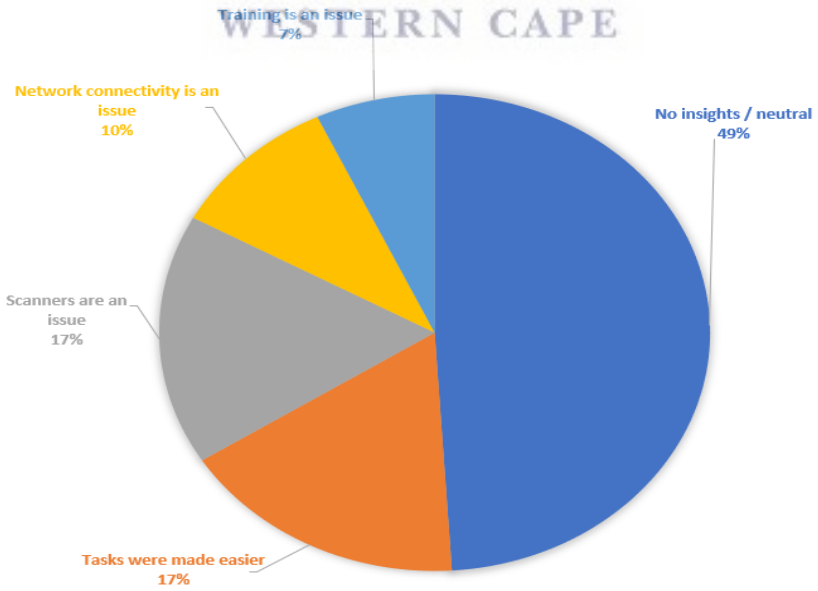


Fig 4.5.11 – Section B4. Q1: Categorization of responses to the open-ended question

This was an open-ended question posed so that the respondents were free to give any answer that they felt provided insights about issues relating to the transition to, and integration of the RFID technology.

As this question was optional, 39% of the participants (which is 117 of 297) responded to this question. The statistics drawn relate to percentages of responses that are categorised, as a percentage of the 117 responses – not a percentage of the total 297 participants. The findings are therefore what follows.

- There were 49% of respondents that indicated they have no insights into the issues relating to adoption of the technology. This could be seen as neutral responses.
- There were 17% of respondents that indicated that the adoption of the technology has made their tasks faster and easier.
- There were 17% of respondents that indicated that the scanners are an issue that is negatively impacting adoption of the technology. This is in part due to the fact that the scanners scan all tags in range, whether it be items on lay-buy or stock on hand. Based on the responses, all staff do not seem to be aware that the counts are skewed due to this. Therefore, the stock on hand scanned does not match with the inventory on hand in the store.
- There were 10% of respondents that indicated that the network connectivity and speed are an issue that is negatively impacting adoption of the technology. Again here, based on the responses, some of the staff attribute the slow responsiveness and the lag of scanner to the hardware itself, and not the network.
- There were 7% of respondents that indicated that training is required and that it is an issue, and that training could furthermore help effective adoption of the technology.

4.6 Discussion of findings

In **Section B1** dealing with the effects of IoT technology adoption on processes in SCM, the majority of respondents indicate that they are of the opinion that it was easy to transition to the new RFID technology and the new process for stock taking and refilling. Their willingness to adopt, the new IoT technology indicates that they have a positive view of the IoT technology, and perhaps a belief that the new technologies will increase control, flexibility and efficiency. To reiterate what was stated in the data analysis, the behaviour of the users depict that described in the *Optimism* dimension of the TRAM model (Parasuraman A. , 2000), (Parasuraman & Colby, 2014), (Lin, Hsin-Yu, & Sher, 2007) and is therefore a good indicator of the users' readiness to transition to and adopt the new technology.

The respondents furthermore indicate that they are of the opinion that adoption of the technology effected a process improvement in locating stock, stock taking, and refilling. And furthermore, enabled the respondents to work more efficiently. These views are aligned to the Digiteum report (Digiteum, 2019) that real-time asset tracking is indeed an area of business value creation derived from IoT technology adoption.

	RJ		MK	
B1.Q1	72%	agree	77%	agree
	23%	neutral	18%	neutral
B1.Q2	84%	agree	88%	agree
	10%	neutral	9%	neutral
B1.Q3	85%	agree	88%	agree
	11%	neutral	8%	neutral
B1.Q4	86%	agree	85%	agree
	7%	neutral	11%	neutral

Table 4.5.1 – Section B1: Responses regarding effects of IoT technology adoption in SCM

In **Section B2** dealing with impediments to the use of RFID technology in processes in SCM, the respondents indicate that they are of the opinion that they have low computer literacy, and that fear of the unknown contributes to resistance to change. The respondents felt that resistance to change from legacy systems to RFID was not a huge issue. Lastly, the idea of adopting RFID has effectively been shared by management. The respondents therefore believe that management has clarified its strategic objective regarding the transition to RFID. The behaviour of the users moreover depicts a connection with the business strategy communicated by management regarding the new technology and processes as described in the *Optimism*

dimension of the TRAM model (Lin, Hsin-Yu, & Sher, 2007) and is therefore a good indicator of the users' readiness to transition to and adopt the new technology.

	RJ		MK	
B2.Q1	34%	agree	41%	agree
	48%	neutral	41%	neutral
B2.Q2	50%	agree	55%	agree
	36%	neutral	29%	neutral
B2.Q3	56%	agree	50%	agree
	31%	neutral	36%	neutral
B2.Q4	28%	agree	33%	agree
	30%	neutral	30%	neutral
B2.Q5	46%	disagree	55%	disagree
	34%	neutral	21%	neutral
B2.Q6	67%	disagree	67%	disagree
	18%	neutral	16%	neutral

Table 4.5.2 – Section B2: Responses regarding impediments to the use of RFID technology adoption in SCM

In **Section B4** the participants were asked an open-ended question requesting their insights into the issues relating to the transition and integration of RFID technology. In this section 49% of the responses are neutral. 17% of responses indicate that the IoT technology adoption has made their tasks at work easier. The technology seems to have furthermore been accepted quite well and most of the respondents have indicated that the technology is an improvement, and not a hinderance to their business process of accepting, refilling, and taking stock of inventory in the store. The user behaviour is as described in the *Optimism* dimension of the TRAM model (Parasuraman & Colby, 2014) and is therefore a good indicator of the users' readiness to transition to and adopt the new technology. 27 % of responses are issues regarding poor network connectivity and scanner operation deemed as impediments to the stock taking and refilling process. Here a stable and reliable internet connection is required for smooth operations, and the absence of it would introduce a single point of failure (Digiteum, 2019). 7% of responses furthermore indicate that insufficient training is an issue impeding the adoption of the IoT technology. Management therefore needs to address this skills gap to ensure successful adoption (Manpower, 2022).

The category split is visualized in the pie chart below in Fig 4.5.11.

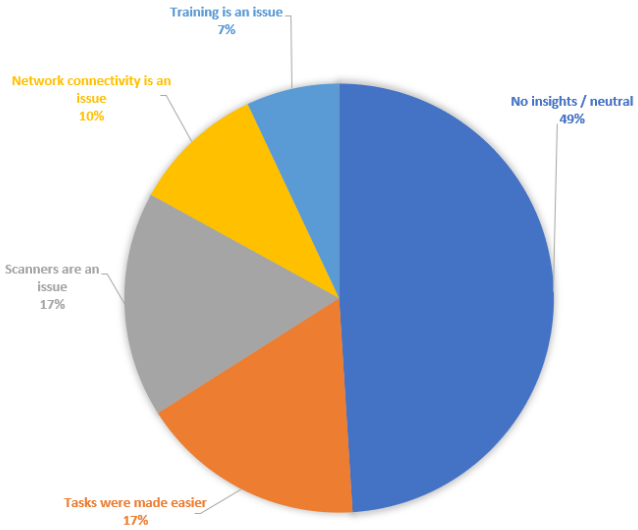


Fig 4.5.11 (repeated) – Section B4.Q1: Categorization of responses to the open-ended question

4.7 Chapter summary

In conclusion, in this chapter the quantitative data collected was analysed and interpreted. Quantitative data was exported to Excel for statistical analysis. The researcher created visualizations of the data to present and briefly discuss the responses of the participants. Results were presented in matrices and bar graphs. The responses were formatted on a Likert scale to gauge the intensity of agreement, or disagreement, with the question posed. The collective responses to each survey question was then analysed and an aggregation of the common responses were calculated and identified. These most common responses for each question were then regarded as the sentiment, or opinion of the group for that specific question, item, or area relating to factors affecting technology adoption. All findings were discussed with support from relevant literature. The last chapter of the study presents the conclusions, recommendations, limitations and contributions of the study.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This last chapter of the study presents conclusions, recommendations, limitations and contributions of the study. The study identified factors affecting the adoption of IoT technology in SCM of a large clothing retailer in the Western Cape. Therefore, literature was consulted to provide a better understanding of the management problem. This was followed by quantitative data collection using a survey from the employees working for the retailer. The first section of this chapter summarises findings from empirical research followed by recommendations, implications for future research, practice and policy. The next section discusses the limitations encountered and the study' contributions.

5.2 Conclusions from the study

5.2.1 Conclusions for objective 1: *To identify factors affecting the adoption of IoT technology in SCM of a large clothing retailer in the Western Cape*

The first objective of the study identified factors that affected the large clothing retailer from adopting IoT technology. Respondents indicated that as poor network connectivity (and perhaps poor internet line speed issues as a result). This is consistent with the Digiteum report (2019) that mentioned that a stable and reliable internet connection with high bandwidth is required for smooth operations, and that the absence of it would introduce a single point of failure (Digiteum, 2019). Respondents indicated that the operation and performance of the RFID scanners were an issue affecting adoption of the technology.

The second recurring factor mentioned by 7% of the respondents, was categorized as training issues. (Manpower, 2022) contends that companies are more concerned with managing costs instead of upskilling and training staff to bridge the technical skills gap. Here it is evident to some degree that responses in this category indicate that there is insufficient ongoing training to help how to use and understand the RFID technology, so this is consistent with Manpower (2022). The respondents furthermore feel that this is also a factor affecting adoption of the RFID technology in their working areas.

5.2.2 Conclusions for objective 2*: To ascertain the effects of IoT technology adoption on the SCM processes of a large clothing retailer in the Western Cape*

The RFID innovation provided a competitive edge in that it improved the previous stock taking and replenishment process. This is consistent with the contention by Morgan (2019) who states that technologies are enhancing efficiency in supply chain processes.

Respondents indicated that the technology and its associated business process changes are an advantage that makes their work easier, and faster. Both of these factors are indicative of user attitudes after successful adoption, and in keeping with user characteristics in the Optimism dimension of the TRAM model (Parasuraman, 2000); (Lin, Hsin-Yu, & Sher, 2007).

5.2.3 Conclusions for objective 3*: To identify interventions that may be applied to improve the adoption of IoT technology in SCM of a large clothing retailer in the Western Cape*

Respondents mentioned training as an intervention to help assist to better use and understand the technology. Manpower (2022) contends that companies should shift focus to upskilling and training staff to bridge the technical skills gap; therefore, training is an intervention that may be applied to improve the adoption of IoT technology.

Management may consider hiring consulting firms with expertise to assess maturity, readiness, and training needs to propose appropriate training programs that can bridge the skills gap and improve technology adoption where required. More focused stakeholder engagement and inclusion, regarding changes to business process where technology is introduced, could be another intervention to improve technology adoption.

5.2.4 Conclusions from literature review

The Fourth Industrial Revolution (4IR) puts forth that advanced technologies like the Internet of Things (IoT), Machine Learning (ML) and Artificial Intelligence (AI) and blockchain have altered the way businesses operate, and that these technological innovations have undoubtedly changed and shaped the way people live, ushering in the global village into the information age (Schwab. 2018:1).

Users of technology are influenced by various factors to adopt or resist new technology and it is management's responsibility inculcate a culture and mindset among employees towards acceptance of technologies (Davis, 1989). The organisation should furthermore assess its culture's readiness by clarifying its mission by establishing clear communication channels and strategies (Davis, 1989). Further to that, the firm must be convinced that it acquires new

technology in support the overall strategic direction of the firm (Parasuraman, 2000). Readiness for adoption can be determined by establishing if users have adopted the tools to aid in performing their tasks in daily practice. Management should communicate any change initiatives to everyone in the company (Karp & Fletcher, 2014).

The Opportunity Map for an effective IoT Strategy (Caro & Sadr, 2019) was presented as a framework to discuss IoT Technology Adoption Strategies. The idea behind this model is to consider and categorise each IoT opportunity based on its perceived capabilities and value it may create. The capability then needs to be labelled either as an 'enabling' or 'enhancing' capability. Enabling capabilities create value by allowing the organisation to perform a current task more efficiently, where an enhancing capability creates value through new opportunities unique to IoT technology (Caro & Sadr, 2019).

Challenges faced in the adoption of IoT technology in SCM and logistics include skills gap, connectivity issues, security issues, and the human aspect of SCM was then discussed (Digiteum, 2019). According to a report by PwC (2016), companies embracing and implementing the latest technologies have been confronted with challenges relating to the shortage of computer engineering skills, financial resources, and alignment of these technologies with existing organisational strategies and technologies.

Customers are becoming increasingly "empowered" due to the proliferation and ease of access to information. Technology on the other hand can assist SCM organisations in expanding their digital offering and reaching new customers (Jakšič & Marinč, 2015). In doing so they ensure that they will survive by using technology and becoming more customer centric Schwab (2018).

South Africa is facing a shortage of IT skills (StatsSA, 2018) and firms need to change the way they conduct their business strategy, skills development, and ways of working. This can partially be addressed through hiring consulting firms with expertise (StatsSA, 2018), as well as in-house training like mentorship and apprenticeship programs for more effective knowledge sharing (Chigada & Ngulube, 2014).

5.3 Recommendations

The recommendations that follow are in a general context and not specifically aimed at the retailer where the study was conducted.

The researcher recommends that management should formulate a clear strategy upfront before introducing a technology such as RFID into business processes. This recommendation is as per Caro & Sadr (2019). This clear strategy and the effective communication thereof are the key for success, for a retailer of the size in this study (Karp & Fletcher, 2014). This may be done by means of staff and stakeholder involvement in workshops and strategy planning seminars and sessions.

In the South African context, management should try to address current the skills shortage by finding a balance between cost reductions for technology innovations and upskilling and training of staff (Manpower, 2022). Close attention would therefore be required in the planning stages to allocate the outlay of expenditure on technology and training while strategies are being deployed. This too may be done by means of workshops and strategy planning seminars and sessions.

A stable, high bandwidth is essential for smooth IoT operations (Digiteum, 2019) and therefore the power supply as well. Management should also plan to ensure that the energy crisis and power outages do not become a factor that causes an IoT technology adoption to fail. Alternative power sources like solar installations or inverter backup solutions may be an option to address this issue. There are also companies that provide mobile solar power solutions (http://mobilesolarpower.co.za/) that may be used to completely replace the power supply.

Given the size of the retailer in this study, for a successful adoption of an IoT technology implementation it could help to first launch a pilot project and limit the impact of the technology to a small group, area, or function in the company. This way the expenditure is much less and lessons can be learnt for feedback so that management can make better informed decisions regarding future expenditure and technology choices that support the strategic direction of the organization (Karp & Fletcher, 2014). This retailer has implemented a pilot on a small scale. It may therefore be better to roll out smaller projects in an appropriate area or division to see if it works out first.

5.4 Implications for future research

Future research might benefit from the findings in this research as it helps to fill the gap in the current literature on the topic of IoT technology adoption in a large retailer in SA. Network connectivity was a significant issue uncovered in this study. Perhaps a new direction that could be focused on could be the relationship between the energy supply crisis in SA and the impact on technology adoption in SCM of large retailers. An academic study focused on the impact

and effects of power outages as well as possible interventions will be very useful for practitioners and policy makers to inform strategic decision making.

It may also be valuable to research other technologies, IoT or otherwise, that may be used to streamline and improve retail business processes. This may be future avenue of research in this area. A comparative South African research study between retailers that have adopted IoT technology in SCM may also be valuable to expand the body of knowledge in this area.

There may be a relationship between communication of the business strategy and the change to the business process that may have been a driver or enabler of the respondents' attitudes (in this study) toward the technology being indicative of those in the Optimism category, according to the TRAM model (Lin, Hsin-Yu, & Sher, 2007). Further research may therefore be warranted to uncover the relationship and dynamics of management's communication of their IoT strategy and the success or failure of adoption in a South African retail context.

5.7 Implications for practice

This research indicates that the key for successful IoT technology adoption is for management to be clear and transparent regarding forthcoming changes to business process, and more specifically, the introduction of new technologies to support business process. Management should communicate the business strategy with all parties concerned before rolling out any changes. Consultations, workshops, staff involvement, and engagements may be held to facilitate to this end.

A successful technology adoption cannot be achieved without the required skilled resources. Training and upskilling of staff are therefore particularly pertinent in the South African context in light of the technical skills shortage, as Manpower (2022) has pointed out.

A well-functioning technology infrastructure is also key for successful operations and subsequent technology adoption (Digiteum, 2019).

5.8 Implications for policy

The Fourth Industrial Revolution (4IR), which puts forth that advanced technologies like the Internet of Things (IoT), Machine Learning (ML), Artificial Intelligence (AI), and blockchain have altered the way businesses operate, and that these technological innovations have undoubtedly changed and shaped the way people live. The data analysis revealed that respondents in the study indicated network connectivity as an issue and impediment that affected adoption of the technology. Policy makers should be aware of the fact that very often

network connectivity issues are due to challenges and shortcomings of the electricity supply in South Africa. And more specifically that a networked IoT technology implementation cannot function without a consistent electricity supply (Digiteum, 2019). This is pertinent, because South Africa is currently facing an energy supply crisis that will not be resolved in the short term. Policy makers therefore have to factor this reality into their planning if we as a country intend to leverage these advanced 4IR technologies and compete with the rest of the world and keep up with the pace that this technology is moving and changing business and life on a global economic scale (Schwab, The Fourth Industrial Revolution, 2016).

5.9 Contributions of the study

This study contributed to the current body of knowledge in the area of IoT technology adoption. This study adds research conducted a large retailer in the Western Cape in South Africa. This research confirms that there is not a skills shortage, and a lack of understanding preventing successful adoption of IoT technology in South Africa. The research also reinforces the ideas of (Parasuraman A. , 2000), that for successful implementation, management needs to first plan and strategize effectively before rolling out new technology into the organization. Executive management of large retailers in SA could therefore benefit from the findings of this study as it furthermore provides insights into technology adoption methods and its effectiveness when looking at the IoT implementation as a case study in a large retailer in South Africa. This contribution may help further future academic research in this area and help fill the gap where similar studies have been performed in other countries besides South Africa.

5.10 Limitations of the study

Limitations are important, because it gives context to research findings, and ascribes a credibility level to the conclusions of a research study. To that end, its pertinent to mention that other areas in the business may also have used IoT technology, but it did not impact stores, or the areas where the respondents work in. The impact of IoT technology was therefore limited only to the business process of acceptance of stock and stock takes/refills in the branches. The survey questions were therefore asked of staff that perform those functions in the branches. The context of the success of the adoption of IoT technology in this case does therefore not apply to the entire organisation, but rather to the impact brought about by the pilot project and the implementation of the technology in the stores.

5.11 Final conclusion

This research study sought to identify factors affecting adoption of IoT technology in SCM of a large clothing retailer in the Western Cape. The research aims and objectives were adequately addressed through the steps and procedures carried out in this study. In this industry, technology is leveraged for a competitive advantage, but the adoption is not always successful. The research problem was then clearly stated that organisations are unsure how to adopt and leverage IoT technology successfully. The research question therefore set out to uncover factors influencing adoption of IoT Technology in the retail space in the Western Cape, SA.

4IR technologies included artificial intelligence, machine learning, blockchain, and IoT – which was the focus of this study. RFID is type of IoT technology that is often used to track and locate valuable products and commodities and this was the technology adopted by the retailer in the study. Challenges of adoption of this technology, effects, as well as interventions were then presented and discussed. The Technology Readiness Adoption Model (TRAM) was then presented for use as a framework to guide the study.

A survey was used to collect the data from participants and respondents working in the branches in various locations in SA. The responses were saved in the form of a flat file. The responses to the survey were then analysed and the interpretation of the responses were then discussed and presented. It was clear from the data analysis that the respondents' attitudes toward the technology fell squarely into the Optimism category of the TRAM model in the context of technology readiness This was a strong indication that the technology adoption was a success at this retailer.

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Appendix A: Questionnaire

Factors affecting adoption of RFID technology in the supply chain: The case of a large clothing retailer in the Western Cape

Department of Information Systems,

Economic and Management Sciences Faculty

at the

University of the Western Cape

Researcher:

Garth Styer

Email: gstyer@uwc.ac.za

Cell: +27 81 439 8604

Dear Respondent

My name is Garth Styer, a master's candidate in the Department of Information Systems, Faculty of Commerce at University of the Western Cape. Currently, I am conducting research on ***"Factors affecting adoption and integration of RFID technology in the supply chain of a large clothing retailer in the Western Cape"***, therefore, I invite you to participate in this study. Your participation in this study is voluntary and you are free to withdraw from the study any time. Your responses will be treated in the strictest confidence, remain confidential and will be invaluable to completing this study. You will not be requested to supply any identifiable or sensitive information in this research. The questionnaire will take approximately 15 minutes to complete. By taking part in this questionnaire, you implicitly give consent to take part in the research study. Should you have any questions regarding the research please feel free to contact the researcher.

SECTION A: DEMOGRAPHIC INFORMATION AND DEDICATED AREA

In this section, you are requested to mark your answer with an X.

Indicate your gender

Male	
Female	
Prefer not to answer	

Indicate your age

18-24 years	
25-44 years	
45 years +	
Prefer not to answer	

Indicate the area that work in

Distribution Center	
Stores	
Quality Assurance	

Planning	
Transportation	
IT	
Operations	
Other (specify)	

How many years of experience do you have working in logistics?

Less than 1 year	
1-5 years	
6-10 years	
11-20 years	
More than 21 years +	

Have you worked in a sector other than logistics in the past? If yes, please specify.

Yes	
No	
Specify the industry you have worked in prior to logistics	

SECTION B.1: Effects of RFID technology on supply chain processes

In this section, you are requested to select only one choice that represents your viewpoint per question. Please indicate your level of agreement with the following statements:

	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
RFID tagging is easy to transition to from the previous barcoding system	1	2	3	4	5

RFID tagging has improved the process of locating stock	1	2	3	4	5
RFID tagging has improved the process of stocktaking / refilling	1	2	3	4	5
RFID tagging has aided you to work more efficiently	1	2	3	4	5

SECTION B.2: The impediments to the use of RFID technology on supply chain processes

In this section, you are requested to give your honest opinion based on your own individual experiences.

	Strongly Disagree	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly Agree**
It is costly to implement RFID technologies	1	2	3	4	5
The level of computer literacy is very low among employees	1	2	3	4	5
Fear of the unknown contributes to employees' resistance	1	2	3	4	5
There is a lack of understanding how RFID technologies can improve efficiency	1	2	3	4	5
Resistance to change from legacy systems to RFID is a huge problem among employees	1	2	3	4	5
The idea of adopting RFID has not effectively been shared with employees	1	2	3	4	5

SECTION B.4: Additional comments

In this section, you are requested to give your honest opinion based on your own individual experiences and views on the issue.

Is there anything else you would like to add to give insight into the issues relating to the transition and integration of RFID technology in your area?

Thank you for your participation in this survey.

Appendix B: Ethical Clearance Certificate

UNIVERSITY of the WESTERN CAPE

60 YEARS of hope, action & knowledge

18 October 2021

Mr G Styer
Information Systems
Faculty of Economic and Management Sciences

HSSREC Reference Number:	HS21/8/17
Project Title:	Factors affecting adoption of IoT technology in the supply chain: The case of a large clothing retailer in the Western Cape
Approval Period:	**15 October 2021 – 15 October 2024**

I hereby certify that the Humanities and Social Science Research Ethics Committee of the University of the Western Cape approved the methodology, and amendments to the ethics of the above mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

Please remember to submit a progress report by 30 November each year for the duration of the project.

For permission to conduct research using student and/or staff data or to distribute research surveys/questionnaires please apply via:
https://sites.google.com/uwc.ac.za/permissionresearch/home

The permission letter must then be submitted to HSSREC for record keeping purposes.

The Committee must be informed of any serious adverse events and/or termination of the study.

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape

Director: Research Development
University of the Western Cape
Private Bag X 17
Bellville 7535
Republic of South Africa
Tel: +27 21 959 4111
Email: research-ethics@uwc.ac.za

NHREC Registration Number: HSSREC-130416-049

FROM HOPE TO ACTION THROUGH KNOWLEDGE.

Appendix C: Informed Consent Form

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Researcher:

Garth Styer

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Consent to conduct Survey and Interview Research

This form serves as consent for a research project to be conducted by Garth Styer from the University of the Western Cape, Department of Information Systems, Economic and Management Sciences Faculty. It is understood that the project is designed to gather information about factors affecting adoption and integration of RFID technology in the supply chain of a large clothing retailer in the Western Cape.

1. Participation in this study is voluntary. Participants will not be paid and may withdraw and discontinue participation at any time without penalty.

2. If participants feel uncomfortable in any way during the survey, they have the right to decline to answer any question or to end the survey.

3. Participation involves completing a survey distributed by Garth Styer. The survey will take approximately 10 -15 minutes.

4. The researcher will not identify participants by name in any reports using information obtained from this survey. Confidentiality as a participant in this study will remain secure. Subsequent uses of records and data will be subject to standard data use policies which protect the anonymity of individuals and institutions they are employed by.

5. The employer may not have access to participant responses. This precaution will prevent comments from having any negative repercussions for participants.

6. This research study has been reviewed and approved by the Ethics Committee at the University of the Western Cape.

7. A copy of this consent form has been given to the representative of the retailer.

19/7/2022

_____ _____

Signature Date

J Jeffery (for TFG)

Printed Name Signature of the Investigator

For further information, please contact:

RESEARCHER: Garth Styer. Email: gstyer@uwc.ac.za; Cell: +27 81 439 8604

SUPERVISOR: Prof. Joel Chigada. Email: jchigada@uwc.ac.za; Cell: +27 74 535 6824