https://dspace.org/

The use of Information Systems within Supply Chain Management to address transport optimisation issues

Naicker, Nerissa

2020-05
https://hdl.handle.net/10539/30094

Downloaded from a DSpace repository. https://dspace.org/

The use of Information Systems within Supply Chain Management to address Transport Optimisation Issues within Selected Companies in the FMCG Industry

Nerissa Naicker

Student number: 1768165

School of Mechanical, Industrial and Aeronautical Engineering

University of the Witwatersrand

Johannesburg, South Africa

Supervisor:

Ms. B Sunjka

May 2020

A Research Report submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Science in Industrial Engineering.

Declaration

I, Nerissa Naicker, student number: 1768165, is registered as a student for MSc Industrial Engineering. I hereby declare the following:

- I am aware that plagiarism (the use of someone else's work without their permission and/or without acknowledging the original source) is wrong.
- I confirm that ALL the work submitted for assessment for the above course is my own unaided work except where I have explicitly indicated otherwise.
- I have followed the required conventions in referencing the thoughts and ideas of others.
- I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my own unaided work or that I have failed to acknowledge the source of the ideas or words in my writing.

Signature: Date: 25 January 2020

Dedication

In Memory of my Beloved Brother,

Eveshen Naicker,

(1989 – 2019)

I dedicate my research report to my dear brother. You are forever in my heart. A beautiful soul is never forgotten. I love you lots.

Acknowledgement

I would like to acknowledge the following people for all the contributions and support through the journey of my Masters:

- Firstly, I would like to thank my husband, Christopher Naidoo, for the continuous support and encouragement throughout my research. Your endless support towards my studies will never go unnoticed.
- I would like to thank my parents and sister, Danny, Saloshna and Trishantha Naicker, for always encouraging and supporting my goals throughout my academic career. It has allowed me to get to where I am today.
- I would like to thank my supervisor, Bernadette Sunjka, for her support and contributions to my research. Thank you for the patience and assistance with all my questions.
- Lastly, to my brother, Eveshen Naicker. It truly has been a challenging year in 2019 with your unfortunate and sudden loss. It was surely a difficult time to get myself together and focus on completing my research knowing you are no longer with us.

Abstract

Supply chain management has grown substantially over the number of years with constant changes and trends occurring to fit the growing global supply chain needs. It has been the key to business success as both a negative and positive impact which will resonate throughout the organisation and affect the performance thereof. The fast-moving consumer goods (FMCG) industry involves an increasingly high-volume of products having to be delivered at fast rates to meet high consumer demands. Ways in which these demands need to be met must be considered to remain competitive. The nature of the FMCG industry assisted in understanding issues that FMCG companies are facing in relation to optimising the road transport management processes and the manner in which the optimisation of the delivery of goods to meet customer volumes and demands are affected.

The focus of the research report was to identify the various transport optimisation issues within the FMCG supply chain industry and further addressed the purpose of information systems and whether it can be implemented to minimise the identified issues. Recommendations on addressing these issues and the impact of information systems on customer service levels within the organisation were further detailed in the research. Many companies are still stuck in the era of manually completing work tasks and processes and the sustainability of this can be questioned. The data analysis involved a comparison between the use of manual-based processes followed by companies and then focused primarily on the use of information systems as a more productive and sustainable solution to address the optimisation issues found. This aided in identifying the differences between the two processes and ultimately being able to determine whether the use of information systems can assist in the optimisation of road transport within the FMCG industry. After the data was analysed, it was identified that there are a number of transport issues affecting the optimisation of businesses. It also identified statistics relating to an IS already implemented and the financial benefits thereof compared to manual-based processes.

List of Figures

Figure 4- 1 Graph displaying the number of respondents per job designation (%) 38
Figure 4- 2 Graph displaying the split between operational processes (%) 39
Figure 4- 3 Graph displaying the transport optimisation challenges (%) 40
Figure 4- 4 Graph displaying the split between manual process and IS used (%) 41
Figure 4- 5 Graph displaying the summary of benefits obtained from the use of IS (%) 42
Figure 4- 6 Graph displaying the number of responses to disadvantages 43
Figure 4- 7 Graph displaying the tools used before system implementations per respondent (%) .. 44
Figure 4- 8 Graph displaying the % of respondents answering if 45
Figure 4- 9 Graph displaying the % of respondents answering if the 46
Figure 4- 10 Graph displaying the responses to challenges of a manual process (%) 47
Figure 4- 11 Graph displaying the level of agreement towards IS significance (%) 48
Figure 4- 12 Graph displaying the number of shipments before and after system implementation 50
Figure 4- 13 Chart displaying the route plan adherence by drivers 51
Figure 4- 14 Graph displaying the number of vehicles per month 51
Figure 4- 15 Graph displaying the average vehicle utilisation per month 52
Figure 4- 16 Graph displaying the vehicle savings per month 53
Figure 4- 17 Graph displaying the total number of vehicles per month 53
Figure 4- 18 Graph displaying the total savings after implementation 54

List of Tables

Table 4. 1 Table showing the number of respondents per job designation 85
Table 4. 2 Table showing the split between operational processes 85
Table 4. 3 Table showing the transport optimisation challenges 85
Table 4. 4 Table showing the responses to challenges of a manual process 86
Table 4. 5 The above table shows the statistics for 6 months pre- and post- go live. 87
Table 4. 6 The table shows the number of shipments 87
Table 4. 7 The table displays the vehicle savings per month 88
Table 4. 8 Chi-square analysis of the split between operational processes 89
Table 4. 9 Chi-square analysis of the transport optimisation challenges 89
Table 4. 10 Chi-square analysis of the summary of benefits obtained from the use of IS 89
Table 4. 11 Chi-square analysis of the number of responses to disadvantages after system implementations 90
Table 4. 12 Chi-square analysis of the tools used before system implementations per respondent 90
Table 4. 13 Chi-square analysis of the number of respondents answering if the system addressed challenges 90
Table 4. 14 Chi-square analysis of the number of respondents answering if the company considered system implementations 90
Table 4. 15 Chi-square analysis of the responses to challenges of a manual process 90
Table 4. 16 Chi-square analysis of the level of agreement towards IS significance 91

Nomenclature

IS	Information Systems
FMCG	Fast Moving Consumer Goods
WMS	Warehouse Management Systems
KPI	Key Performance Indicators
TMS	Transport Management Systems
RFID	Radio Frequency Identification Device
DIF	Delivery in-full
DOT	Delivery on-time
DIFOT	Delivery in-full on-time
ERP	Enterprise Resource Planning
SOP	Standard Operating Procedure
GPS	Global Positioning Units
ePOD	Electronic Proof of Delivery

Table of Contents

CHAPTER 1 1
1. INTRODUCTION 1
1.1. Research Background and Context 1
1.2. Problem Statement 3
1.3. Research Questions 4
1.4. Research Objectives 4
1.5. Summary of the Research Method 5
1.6. Limitations and Constraints of Study 5
1.7. Outline of Chapters 5

CHAPTER 2 7
2. LITERATURE REVIEW 7
2.1. Understanding the Growth in FMCG Supply Chain Management: 7
2.2. Challenges experienced in Transportation Management: 8
2.3. Key Performance Indicators in Supply Chain Management 9
2.4. The concept of Information Systems within Supply Chain Management: 10
2.5. The Challenges of Using a Manual-Based Process: 12
2.6. The Impact and Future of Information Systems within FMCG Supply Chains: 12
2.7. Growth in Customer Demand and Expectations within the FMCG Industry 14
2.8. Road Transport Information Systems 14
2.9. Supply Chain 4.0 15
2.10. Conceptual Framework 16
2.11. Summary of Literature Review 19

CHAPTER 3 20
3. RESEARCH METHODS 20
3.1. Research Design 20
3.2. Instrumentation 22
3.3. Sampling 27
3.4. Data Collection Procedure 28
3.5. Data Analysis Procedure 32
3.6. Chi-Square Test 34
3.7. Reliability and Validity 34
3.8. Ethical Issues/Clearance 36
3.9. Summary of the Research Methodology 36

CHAPTER 4 37
4. DATA ANALYSIS AND RESULTS 37
4.1. Analysis of the Survey: 37
4.2. Analysis of the Historical KPI and Transactional Data: 48

CHAPTER 5 55
5. DISCUSSION 55
5.1. Current Transport Operations 55
5.2. Transport Optimisation Challenges 58
5.3. The Use of Manual-Based Processes and Challenges 59
5.4. Information Systems Used and The Benefits Obtained to address Transport Optimisation Issues 61
5.5. Comparison between Manual-Based and IS-Based Processes: 64
5.6. The Challenges with IS Implementations 65
5.7. Reasons why Companies are not Implementing Systems within the Business 66
5.8. Reasons why Companies want to Implement Systems within the Business 67
5.9. Summary of the Discussion 68

CHAPTER 6 69
6. CONCLUSION AND RECOMMENDATIONS 69

REFERENCES 75
APPENDICES 79

CHAPTER 1

1. INTRODUCTION

1.1. Research Background and Context

Supply chains around the world are undergoing drastic changes that are being driven by constant global developments and external competitive forces causing companies to rethink the management and optimisation of supply chains (Sabri, 2015). Hence, it is crucial to create a link between the optimisation and performance of the supply chain and the company (Camman, C. et al, 2017). An important factor for any company's success and customer satisfaction growth is to take into account effective supply chain strategies (Sabbghi, 2011). In 2014, a study was conducted whereby it was identified that 79% of companies achieved an above-average growth in revenue due to maintaining a high-performing supply chain (Deloitte, 2014). On the other hand, 50% of businesses closed within five years of commencement as a result of underperforming supply chains (Logistics Bureau, 2019).

The aim of supply chain management is to ensure the integration and co-ordination of the activities between suppliers, customers and business partners that all form part of the interconnected value chain involving the flow of products and services (Awad & Nassar, 2010). Awad & Nassar (2010) further explain that many organisations face supply chain problems which is often found with more complex operations being managed. However, the more complex the operation, the more difficult it becomes to manage the supply chain leading to problematic execution of service delivery and cost reduction if not managed in the appropriate manner required. Majority of organisations have begun to place a high focus on the importance of supply chain management to ensure the functionality and success of the operation (Meyer, 2019). It is further stated that organisations need to place focus on examining practices and strategies on how to continuously improve supply chain activities to ensure the most optimal business performance is achieved (Nguegan & Mafini, 2017).

Dempsey (2017) explained that challenges within supply chains have become a major concern due to the unpredictability of customer demand for faster responses and delivery times which 90% of supply chain leaders deem as one of the greatest challenges experienced today. The challenge of customer uncertainty and unpredictability has made the improvement of customer services more difficult to achieve leading to a greater focus on supply chain efficiency within the organisation (Angkiriwang, Pujawan & Santosa, 2014).

Customer expectations for enhanced services is a top driver in achieving optimal profitability and business growth. Businesses gain competitive advantage through the ability of offering superior customer service further resulting in customer retention and profit growth (Hinson, et al, 2019). In 2017, improving customer service was the top objective of 75% of companies (Forbes, 2017). The enabler of ensuring corporate success and achieving customer service and cost reductions relies heavily on the organisation identifying customer

requirements and being able to meet those requirements by managing the supply chain activities from the start of the process until the delivery takes place (Wisner, Tan & Leong 2014). An emphasis should be placed on understanding customer demands and aligning this to the supply chain strategy design in order to develop a customer relationship strategy that can handle various customer related issues (Wisner, Tan & Leong 2014). Wisner, Tan & Leong (2014) explained that the customer related activities become an important factor within the supply chain as the customer ultimately has an overall impact on the success and profit growth of the organisation.

The fast-moving consumer goods (FMCG) industry has faced multiple challenges over the years when reviewing the management of supply chains. The FMCG industry is a complex trading environment that involves a large number of companies finding ways in which to expand business and profits (Van Niekerk & Bean, 2019). It represents one of the largest industries in the world with substantially high-volumes due to the constant demand from consumers (KPMG, 2016). KPMG (2018) conducted a study where the top challenges of the industry were ranked. The highest ranked challenge found is the optimisation of the distribution network. The other four challenges ranked were the cost of fuel, the implementation of efficient planning and forecasting tools, potential failure of key suppliers, and the adaptability of the supply chain to economic slowdown. Based on this study conducted by KPMG (2018), the road transport management aspect of the supply chain involves various challenges that businesses experience. Three of the five challenges relate to transport management and information systems (IS) which ultimately will have an impact on the operations and customer service delivery if no solution is generated to address these challenges. With high volumes of product flow and ensuring quick response and delivery times to customers, the FMCG industry must adapt a complex and efficient supply chain strategy to overcome the challenges identified (Kumar & Bala, 2011).

Within all supply chains, transport plays an important role and function that has an impact on almost all aspects of the business as it can be viewed as the glue that facilitates the supply chain model functionality (Coyle, et al, 2013). Transport management is the most important activity within the supply chain and among the total logistics costs, the costs of transport usually equates to more than one-fourth of the total (Grabara, Kolcun & Kot, 2014). This function allows the business to have direct contact with the customer in terms of ensuring the delivery of goods have taken place effectively by delivering the right product, at the right time, in the right quantity and quality, at the right costs and to the right location (Coyle, et al, 2013). Road transport management can cause disruptions and delays if not managed efficiently. Hence, the importance and vital role that businesses need to play when it comes to the transport management within the supply chain and meeting customer demands (PLS Logistics, 2015).

Supply chain success relies heavily on both internal and external collaboration and the sharing of information across the supply chain (Mashiloane, Mafini & Pooe, R, 2018). Information has become an essential aspect of ensuring accurate and timely integration of the supply chain (Awad & Nassar, 2010). According to Fish (2011), improved decisions can be made through information sharing and collaboration which in turn results

in better use of resources and achieving the goal of reduced supply chain costs and meeting the growing levels of customer demand.

With the growth in customer demand and ensuring the business and supply chain are aligned accordingly, comes the evolution and rapid change in the industry of real-time and accurate data through the use of IS (O'Marah, 2014). According to Dwivedi (2016), gaining advantages to minimise transport costs and improve customer service and flexibility can be achieved through the implementation of IS. IS involves the modelling and management of decision making and provides the organisation with key data throughout each activity within the supply chain operation (Barreto, Amaral & Pereira, 2017). Morgan (2019) explained that the increase in demand from customers have led companies to reconsider supply chain strategies and one of these solutions involved the digitalisation of supply chains which has the potential to reduce costs and meet the complex customer demand requirements within the FMCG industry.

According to Bhandari (2015), technology has become a critical element in supply chain success and innovation which has led many businesses to implement a component of IS such as a transport management system (TMS). As discussed by Barreto, Amaral & Pereira (2017), a TMS involves the interaction between the order management system and distribution centre or warehouse of a company making it possible to integrate aspects of the operation for a more integrated solution. It improves information sharing, ultimately leading to enhanced collaboration which is essential in supply chain management and to ensure customer demands and requirements are met. A TMS solution is not only viewed as a change facilitator but also leads to greater efficiency and effectiveness throughout the various levels of the organisation (Coyle, et al, 2013). Mason & Lalwani (2007) explained that taking a systems perspective enables the supply chain components to be integrated allowing a reduction in costs and improved customer service.

If supply chain IS is adopted as part of a supply chain setup within the FMCG industry, the process needs to be measured and monitored accurately in order to reap optimised benefits for the business. Often supply chain managers implement systems as a solution but do not properly understand the complexities or further risks that could occur (Kumar & Bala, 2011). Kumar & Bala (2011) explained that the most appropriate solution must be implemented which will allow the business to gain beneficial results.

1.2. Problem Statement

A need for a more innovative way of increasing efficiencies and a streamlined supply chain process has become an essential requirement within supply chains (Li, 2014). One of the greatest changes has been the advancement of technology and IS which has allowed the industry to take operations to the next level (Min, Zacharia & Smith, 2019). Based on past research, it is evident that there are certainly gaps in the road transport management area within supply chains (Cannella, et al, 2017). Current observations indicate that many companies face issues of improper transport planning and optimisation, pressure from high-volumes and increasing fuel prices, to name a few issues, which leads to not being able to fully utilise the fleet in an efficient

manner but ultimately results in a reduction of cost savings and not having the ability to fully meet increasing levels of customer demand (Kant, 2014).

According to the Cavalcante (2013), there are many organisations that continue to use traditional business models such as paper-based or Microsoft Excel models. These manual-based models, however, are failing in the new digital era in which technology is increasingly being used to address current challenges experienced and therefore, may not be the most optimal and efficient manner of operating the business (Barloworld Logistics, 2017). In order to gain a competitive advantage within this fast-growing industry, innovation is key. Organisations will need to make use of current and future trends within the market that can assist accordingly.

With supply chain management containing various elements of the business, this study thus investigated how the use of IS can assist within supply chain management with specific focus on the improvement of road transport optimisation issues within selected companies in the FMCG industry.

1.3. Research Questions

The critical research question for this study is therefore,

How will the adoption of information systems impact the road transport management in selected South African FMCG supply chains?

1.4. Research Objectives

The purpose of this study is to identify how the current issues across supply chains can be improved using IS. IS within supply chain management can be broad and hence for this study, the focus area will be based on how transport optimisation issues can be addressed using IS within the FMCG supply chain industry in South Africa.

The objectives of this research are to:

a. Identify the key issues experienced currently in road transport management in selected South African FMCG supply chains.
b. Assess the differences between using a manual-based process and an automated IS process with regards to addressing the transport optimisation issues identified.
c. Make recommendation as to how IS may improve the customer service levels in these supply chains.

1.5. Summary of the Research Method

A mixed research method has been selected for the purpose of this study. The research method involved a sample size of 20 respondents where online questionnaires were sent to individuals in selected companies within the supply chain and FMCG industry. The quantitative data was provided by a supply chain consulting company that contained historical KPI and transactional data for a company in the FMCG industry. For the qualitative research, Survey Monkey was used to collect the data. Both sets of data were analysed by first sorting, organising and using coding to make the data more manageable. The use of descriptive analysis was selected to create statistics based on the findings to validate the research question.

The ethics clearance number for the research report is MIAEC 122/18.

1.6. Limitations and Constraints of Study

The scope of the research report was limited to only the road transport management aspect of supply chain management and further confined to selected companies within the South African FMCG industry. The researcher chose to focus on one industry due to limitations of time to carry out the data collection and proper analysis to get definite results.

1.7. Outline of Chapters

1.7.1. Chapter 1: Introduction

Chapter 1 outlines the background of the research describing the purpose. The chapter also describes the research problem, research question and objectives for the study. This chapter is essential as it forms the basis of the study.

1.7.2. Chapter 2: Literature Review

This chapter outlines the literature review which provides a summary of past research of transport optimisation issues and the impacts of IS on both the supply chain industry and FMCG industry.

1.7.3. Chapter 3: Research Design and Methodology

This chapter focuses on the research methodology that was carried out to conduct this study. It explained the population, sample, method for the data collection and analysis as well as the ethics clearance and reliability and validity of the study.

1.7.4. Chapter 4: Data Analysis and Results

Chapter 4 demonstrates the basis of the analysis once the data was collected and how it was carried out. It will then display the results of the data analysis as the outcomes of the study.

1.7.5. Chapter 5: Discussion

This chapter will discuss the results of the data collection and how it relates to the study on hand and the literature review.

1.7.6. Chapter 6: Conclusion and Recommendations

The last chapter then concludes the study describing the final outcome. It will also describe recommendations in relation to the research problem.

CHAPTER 2

2. LITERATURE REVIEW

This literature review explores specific streams of research to aid in answering the research question. This chapter includes the following sections:

- Section 2.1: Understanding the Growth in FMCG Supply Chain Management
- Section 2.2: Challenges experienced in Transportation Management
- Section 2.3: Key Performance Indicators in Supply Chain Management
- Section 2.4: The concept of Information Systems within Supply Chain Management
- Section 2.5: The Challenges of Using a Manual-Based Process
- Section 2.6: The Impact and Future of Information Systems within FMCG Supply Chains
- Section 2.7: Growth in Customer Demand and Expectations within the FMCG Industry
- Section 2.8: Road Transport Information Systems
- Section 2.9: Supply Chain 4.0
- Section 2.10: The Conceptual Framework
- Section 2.11: Summary of Literature Review

2.1. Understanding the Growth in FMCG Supply Chain Management:

According to Van Niekerk & Bean (2019), the FMCG industry comprises of low-cost commodities that have high demand and volume levels. These goods have a shorter shelf life with a demand for products that are growing each day. With such high volumes and increased demand, the supply chain model needs to be optimised and efficient (Barloworld Logistics, 2017). Barloworld Logistics (2017) further explained that the FMCG industry has experienced significant growth in recent years due to the expansion of the e-commerce platform, changing consumer spending patterns as well as the increase in demand for quicker delivery of goods.

With such growth in the industry, comes the pressure for companies to be more efficient and cost competitive (Ogunlela, 2018). In addition to gaining a competitive advantage, comes the need for supply chain integration which involves the alignment between people, processes, information and strategies across the supply chain (Johnson & Stevens, 2016). Johnson & Stevens (2016) further described supplier integration and partnerships as having become important for the implementation of more sophisticated solutions such as automated warehouse processes, live tracking and efficient delivery communication to end customers to ensure a seamless integration between all flows of the operation. Agig, Niemann & Kotze (2016) explained that the use of supply chain intelligence will allow organisations within the FMCG industry to improve overall control and visibility of the entire supply chain. By having this level of visibility, the business will have complete awareness of the supply chain as a strategic measurement to provide excellent service levels and ultimately optimise the business (Agig, Niemann & Kotze, 2016).

Organisations should cater for the highest level of services and quicker delivery times to end customers. The FMCG industry is on a constant incline in terms of growth and hence, proper supply chain management solutions are vital as consumer demands and knowledge are constantly evolving, such as same or next day delivery (Ray, et al., 2016). Companies that can provide this type of services, considering the type of FMCG commodities, will gain a substantial competitive advantage. Customer service involves the ability to provide both time and place utility where value will only be added once the product or service has been delivered to the customer (Christopher, 2011). Hence, the importance of road transport management and strategies to enable the achievement of the customer service growth within the FMCG industry.

2.2. Challenges experienced in Transportation Management:

According to Frost (2018), supply chain and logistics management plays a vital role in the facilitation of operational success. Some of the issues Frost (2018) mentioned as challenges include constant changing of consumer demand and complex business models which could hinder a streamlined process. One of the key challenges currently faced in South Africa and continues to be an issue is the growing fuel price. Fuel costs contribute to transportation having the largest cost within the supply chain (Grabara, Kolcun & Kot, 2014). Hence, the importance of cutting fuel costs have become essential. With other increases, such as the value-added tax (VAT) increasing from 14% to 15%, this has also become an additional contributor to the expense of transportation in South Africa.

Supply chain integration has been recognised as a significant process to reduce costs and improve service levels, transport has been managed discretely and as a silo activity as opposed to an integrated process with other supply chain activities (Mason & Lalwani, 2007). As a result, increased transport costs are incurred due to poor management. Mason & Lalwani (2007) further explain that improvement within transport management is urgently required and one of the ways to improve this is the measurement of vehicle utilisation, to reduce empty running rates, and strengthen fleet utilisation rates.

There are several issues identified that have an impact on the supply chain. These include high fuel prices as mentioned above, increase in daily traffic and idle-time, vehicle maintenance costs, and the increase in the frequency of delivery times due to a spike in customer demand (Standard Bank, 2017). Saeed & Kersten (2019) explained that the range of challenges being experienced also involves issues such as driver shortages and growing consumer demand. All of which involves the relationship between reduction in cost and maximising profits as well as improving customer service.

Another key challenge currently experienced and will also continue to escalate is the increase in customer demand for improved customer services and value (McFarlane, 2013). In a modern and digital era where e-commerce has evolved significantly, customers require quick response rates and regular status updates of the entire order fulfilment process from the time the order is placed to the time it is delivered (Ramachandran & Neelakrishnan, 2017). According to Logistics Management (2017), the location of a customer's package is as

interconnected as social networks today. Logistics Management (2017) explained that while customer expectations have increased, the willingness to pay for delivery that is less than two days have decreased by 64%. Customers are expecting improved and faster service delivery and a manual paper-based process might not be able to fulfil this expectation.

Another issue Logistics Management (2017) has highlighted is business process improvement. Businesses have come to an understanding that in order to gain a competitive advantage within the industry, companies need to take advantage of new advances and trends. The challenge, however, comes into play during the adoption and onboarding process which to many businesses seems to be overwhelming and can end up being a bigger challenge than before. This ends up placing the business in a difficult situation where competition continues to grow and failure to act upon this can result in a downward spiral (Logistics Management, 2017).

Other challenges that are experienced include businesses having to deal with large amounts of data and processing which can be time-consuming and tedious when performed manually as well as having to deal with the shortage of skilled labour (Belfreight, 2016). According to Belfreight (2016), 39% of international freight businesses are experiencing the issue of recruiting people with the required skills for a modern logistics operation.

2.3. Key Performance Indicators in Supply Chain Management

Supply chain operations require constant focus on improving the business and processes to remain competitive. The performance of the supply chain must be measured to ensure the business is running as expected and achieving the performance targets set (Stefanovic, 2014). These are referred to as key performance indicators (KPIs).

It is defined as an objective measurement of the progress made within the operation against a pre-determined standard (Logistics Bureau, 2018). The Logistics Bureau (2018) described examples of KPIs as the following:

- Delivery in-full (DIF)
- Delivery on-time (DOT)
- Delivery in-full on-time (DIFOT)
- Inventory stock turns in days
- Total transport cost

Bhatti, Awan, & Razaq (2014) explained that an important KPI that is required for the measurement of delivery performance is the monitoring of on-time delivery and shipments. It is further explained by Selected Hub (2018) that 24% of people consider three days to be an acceptable time as a non-urgent delivery window. Whereas, 68% of people deem this delivery window to be two days. Therefore, the requirement to meet customer demand is essential.

Supply chain KPI measurements can assist in determining any gaps between transport planning and execution of the deliveries. This will help the organisation identify any potential problems and improvement areas (Karl et al, 2018).

2.4. The concept of Information Systems within Supply Chain Management:

Supply chain management involves the flow of goods and information within the organisation (Mason & Lalwani, 2007). With the development of technology within supply chain, information has become more easily transferrable which minimises the cost of information due to the increase in technology accessibility (Varma & Khan, 2014). The article further described information flow in the late 1980's as being a very manual-based process where instead of technology, paper was used as a means of managing the supply chain and information flow. WordPress (2012) identified three key factors that has changed the way in which businesses view the importance of technology. These include, the importance of customer satisfaction, the realisation that information flow is as critical as any other aspect within the business that can assist in reducing inventory and improving the overall order fulfilment process and lastly, strategic planning has been improved due to information and the means of technology (WordPress, 2012).

Kakhki & Vidyaranya (2019) explained that one of the most important resources that have been identified in supply chain is the flow of information. Information sharing improves the collaboration amongst logistics partners both internally and externally. It assists in ensuring activities are better coordinated in order to increase performance among all supply chain partners which in turn leads to collaboration that is essential for strategic alignment (Mathu & Phetla, 2018). However, as information is shared, there are possibilities of distortion and vulnerability if it is not properly managed which could affect what needs to be achieved through the flow of information. Hence, Kakhki & Vidyaranya (2019) further highlights the importance of the use of IS that can assist in the facilitation of the information flow within the supply chain.

According to Chrisos (2018), technology enables a better working relationship between employees and employers by ensuring more readily available information flows, streamlined storage of data and an improved data analytical power. The benefits of technology and IS in supply chain management will increase as technology continues to grow (Chrisos, 2018). Chrisos (2018) further explained that supply chain management has various impacts on almost all businesses, including the quality of products and the delivery service levels to end customers. As the level of growth and demand increases, organisations require developments that will lead to improved service delivery such as technological developments.

Road Transport IS involves various concepts and tools, such as the use of telematics, route optimisers as well as track and trace solutions to gain real-time tracking of vehicles and routes. Such solutions aid in the efficient management of the fleet and overall distribution process (Mathu, 2019). According to Mason & Lalwani (2007), there is major confusion about the understanding and importance of IS breakthroughs resulting in a negative effect on profitability and performance, leading to an inability in making changes to the way things

are done within the transport aspect of the business. The overall manner in which the business operates should change.

A study highlighted that technological developments will be a key focus area in influencing business strategies as well as the way in which business operates (Barloworld Logistics, 2017). However, the study also emphasised the challenges around the lack of knowledge with adopting technology in supply chain management. Many businesses are considering the cost implications relating to the implementation of an element of technology or IS as opposed to the benefits that could be gained. According to the Transport Topic (2017), there are big gaps in understanding how technology can be used for companies to gain benefits.

According to Koster, Carstens & Heyns (2017), the use of transport management systems (TMS) has increased vastly and is set to continue with greater demand. The integration of an IS solution, such as a TMS, will allow the organisation to experience seamless integration of processes throughout the operation to ensure optimised supply chain processes which will eventually lead to the redundancy of paper-based environments (Koster, Carstens & Heyns, 2017). The integration will also allow for an automated end-to-end processing and delivery of orders. Grabara, Kolcun & Kot (2014) explained that organisations will need to review supply chain objectives to allow for adaption to market trends and advances which ultimately could result in competitive advantages.

Grabara, Kolcun & Kot (2014) have identified a few benefits of the use of information technology implemented within supply chain organisations. These include the following:

- Streamlining which ensures a more effective manner of communication and collaboration amongst supply chain partners and exchange of information.
- Maximising the connectivity between understanding customer needs and how to improve the business model to manage these needs.
- The reduction of incorrect delivery of orders.
- The flow of production can be improved based on the availability and capacity of vehicles and order processing.
- Optimise the daily use of the fleet based on orders which minimises the costs and improves customer satisfaction.
- Improvement in the overall transport efficiency and profitability.
- The ability to monitor and track vehicles along the route.
- Optimise and better utilisation of delivery plans and driver adherences.

2.5. The Challenges of Using a Manual-Based Process:

According to Kositzky (2012), manual planning involves a number of tasks such as the ability to calculate and adjust the plan for the most optimal routes, maximum capacity, allowed driver hours and total number of delivery stops which can be time consuming, demanding and require a lot of intellectual knowledge into how this gets done.

Kositzky (2012) further explained that with the incorporation of a system or software that can assist with routing and scheduling will bring in the enablement of other business logic and rules that can make the process much more seamless and efficient. The use of a system can take a few minutes and can be easily re-run to accommodate last minute changes. Coyle, et al., (2013) explained that a large number of hours can be required to derive a planned scheduled for deliveries doing it manually whereas a TMS can provide a more optimal and efficient solution within minutes. This is a key step in customer service delivery (Coyle, et al., 2013). The ability to meet customer's delivery date expectations is important and if the plan is incorrectly completed, there could be a possibility of missing the customer's delivery during execution for a number of reasons such as traffic, no visibility of deliveries and ineffective communication with the driver.

Operations can also be enhanced by introducing an IS which has the capability of maximising loads and minimizing the total distance travelled, ultimately saving on transport costs, which with human involvement alone may seem unlikely to complete correctly. There is an average of 10 to 25 percent overall reduction in vehicles and driving hours when comparing the use of an IS and a manual-based process which results in a transport costs saving of 8 to 15 percent (Kositzky, 2012).

Kant (2014) explained that with industry trends, the need for integrated real-time data is essential in the operation. It allows the for more advanced technology to be introduced rather than continuing with manual ways of operating. Kant (2014) described the use of communication devices that allows drivers. Management and customers to be informed at all times improving the transparency, employee satisfaction as well as greater customer offerings and services. These are trends businesses need to consider when remaining in a working environment that is manually driven.

Therefore, it is key to consider all impacts of both processes in order to improve the overall transport management process and optimisation challenges experienced.

2.6. The Impact and Future of Information Systems within FMCG Supply Chains:

According to Mason & Lalwani (2007), as technology continues to improve, tools and software are being developed that facilitate better movement of information to logistics partners which in turn assists in improved collaboration. Although personal communication will remain a necessity, automated IS will assist in ensuring faster and more accurate supply chain collaboration among both internal and external parties.

There are various forms of IS that organisations can use to make use of market trends and advantages. As the advancement of technology and transport IS continues to expand, organisations that take advantage of systems that are available will secure an operation that allows for better logistical planning utilising algorithms that determine the most optimal solution in relation to carrier selection, route planning, vehicle loading, and live tracking and monitoring of vehicles and trips to customers (Council of Supply Chain Management Professionals, Fawcett S.E & Fawcett A.M, 2014). Solutions designed to provide real-time tracking will assist organisations in providing customers with a more accurate delivery arrival time which will lead to advanced customer service levels. Such solutions are designed with the aim of assisting organisations with historic traffic information, driving behaviour and planned versus actual route comparisons and the ability to make logistical adjustments where needed (Shamsuzzoha & Helo, 2011).

FMCG companies are aiming to reduce costs in all corners due to the increase in food price inflations. By driving supply chain efficiencies, FMCG companies can use technology such as radio frequency identification devices (RFID) which will allow the company to see the duration of an order from dispatch to the delivery to the customer. This data will allow the business to improve the level of efficiency substantially based on the data received and managing operations based on this information (Caporarello, L et al, 2016).

Another important aspect of the use of IS is the introduction of electronic data interchange (EDI) which is the enabler of collaboration between supply chain partners. EDI can be used to integrate the systems of two partners which improves efficiency by speeding the information flow from one system to another (Goksoy, Vayvay & Karabulut, 2012). It refers to a computer to computer-based process of exchanging information. Some of the benefits identified include quick process to information, improved customer service, less use of paper-based processes, productivity improvement, greater visibility of track and trace of vehicles and orders, cost efficiency and a larger competitive advantage (Narayanan, Marucheck & Handfield, 2009). EDI can improve the overall business performance due to the real time data and information flows.

The growth of supply chain technology and systems have increased considerably. A study provided by KPMG (2018) showed that in 2017, the supply chain technology industry was valued at $13 billion which increased by 11% from 2016. The study further identified that there is an expected increase of an additional $19 billion by 2021. The advancements of IS are turning the supply chain industry into an evolution from linear responsive flows to networks that are interconnected and can supply smart, predictable solutions (KPMG, 2018). These technologies have been designed with the focus of cost savings and customers as the main key. As consumer knowledge increases, organisations are required to use solutions to allow quick response times to customer demand without jeopardising service levels. The organisations that are taking advantage of these opportunities are experiencing a significant spike in supply chain performance such as a reduction in inventory, improved transport processes and costs, connected and shared data, a reduction in the number of returns and a substantial improvement in consumer experience (KPMG, 2018).

2.7. Growth in Customer Demand and Expectations within the FMCG Industry

The world of supply chain digitalisation has created a major disruption within the industry and has made companies rethink the way the supply chain process is designed. While this is happening, customer knowledge and expectations around the entire order fulfilment process continues to increase (Alicke, 2017). Customers today are being referred to as the empowered customer due to the growth in both innovation and technology which have increased the level of expectations and knowledge of customers (KPMG, 2018). Information sources and alternative purchasing options have also increased as a result of connectivity, empowerment and consciousness of customers.

Customers are increasingly expecting more from companies in terms of quicker delivery times, faster response times to queries, efficient return processes and improved communication in terms of the status of deliveries. In order for the organisation to cater for all these requirements and be able to manage and maintain the expectations of customers, the company needs to ensure a faster and more precise supply chain solution (Russo & Confente, 2017). Studies show that customers are willing to pay extra for products purely for customisation and quicker delivery times (KPMG, 2018). All these expectations are additional pressure which many companies face pushing the supply chain environment to become more versatile, transparent and agile (KPMG, 2018).

According to a survey conducted, the average customer has an expectation of 4.5 days as a maximum delivery window (Henderson, 2018). As a result of trying to meet these needs, more and more companies are attempting to expand the networks of warehouse and distribution centres to ensure quicker delivery times can be met. One of the goals of a company should be to ensure the value proposition on how to achieve optimal customer service is determined and fully understood. It is one thing to have a value proposition but to make a company a market leader is identifying the key on how well the proposition is delivered to effectively manage the customer's expectations (McFarlane, 2013).

2.8. Road Transport Information Systems

Technology has improved significantly over the number of years which has allowed an increase in the number of benefits gained by supply chain professionals. Various improvements have taken place to include software and wireless systems such as smart phone applications, live tracking of deliveries, and routing and scheduling systems (James, 2013). These will continue to have a great impact on the future of supply chain management. James (2013) further described technology as a quicker way for all employees to access large amounts of data, analyse it and use the information in a meaningful manner.

A transport management system (TMS) is defined as a web-based or cloud-based platform that allows any user to be able to manage and optimise the operation of vehicles on a daily basis with a primary function of planning and executing the physical movement of goods (Griffis & Goldsby, 2007).

Some examples of current transport systems and software in place included systems that allow the management of time windows, vehicle management such as vehicle restrictions, utilisations and exclusions and the ability to maximise the use of fleet when delivering any sized orders. Maximising the fleet for specific order sizes relates to the vehicle capacity utilisation based on the volumetric of orders (Ray, et al., 2016). Ray, et al., (2016) further described some key advantages in the FMCG industry as the following:

- To reduce the waiting time at distribution centres, suppliers and retail stores.
- To increase the vehicle utilisation for the high volumes and demands.
- To ensure the routing and scheduling system is configured and aligned to the business' specific requirements and needs.
- To optimise the network design and distribution points to decrease the cost of operations and delivery.

Other available IS solutions include analytics systems to measure KPIs that can be customised to businesses and supply chains. Rather than using Excel sheets, a system can be utilised to accurately monitor and measure the KPIs (Stefanovic, 2014). Another option is the use of a supply chain system that provides visibility and insight into the various supply chain processes to improve communication amongst all parties in the company. This will improve overall collaboration which ultimately increases efficiency and customer satisfaction (Stefanovic, 2014).

A TMS solution involves order processing and distribution as well as planning and scheduling the orders for delivery. With this system comes a number of variables or elements that need to be considered when setting up the constraints of the system. The system will consider all the elements that have been set up to examine a number of different scenarios that best schedules the orders, suggests the most optimal scenario and then selects the vehicle based on availability and capacities (Griffis & Goldsby, 2007).

According to Giusti, et al., (2019) having an IS will assist with efficient transport loading and route planning, real-time distribution tracking and execution management, continuous performance monitoring as well as integrated supply chain management.

2.9. Supply Chain 4.0

According to Alicke (2017), supply chain 4.0 is a new industry and revolution where the application of Internet of Things, the use of advanced robotics and advanced analytics of data within supply chain management is used. It is about automating the entire supply chain process by using warehouse sensors, creating advanced networks around the country to service all customers as well as the ability to analyse data to improve performance and customer service provided (Alicke, 2017).

Digitalisation within supply chain will bring about the following to the industry and companies:

2.9.1. Faster delivery times:

A new approach to the distribution process will be taken where it will be built by advanced forecasting approaches to determine predictive shipping based on weekly forecasts which was created by Amazon where products are shipped before the customer places an order (Domenico, 2019). This is done through the weekly forecasts and historic trends. Alicke (2017) explained that this will work by receiving the customer's order and then matching it to a shipment that is already being transported in the region of the customer. The shipment is then re-routed to the exact customer delivery address. Domenico (2019) explained that the predictive shipment of products will be dispatched to shipping hubs where it will be stored based on the forecasts and once an order is received, it will be matched and ready to be delivered in a much shorter time frame.

Although this is a concept that requires much more research and analysis, it is an approach that will be hitting the supply chain industry along with other similar techniques which will affect companies' abilities to service customers more effectively to remain competitive.

2.9.2. More Flexibility:

Alicke (2017) explained this as the planning of transport to allow for more flexibility in terms of optimising vehicle utilisation by applying a cross-company transport optimisation model where vehicle capacities are shared among different companies or warehouses.

2.9.3. Cost Impacts:

In the next two to three years, the impact of Supply Chain 4.0 will be substantial. Alicke (2017) predicts that operational costs will reduce by 30%, lost sales will decrease by 75% and inventory will reduce by 75% while the supply chain agility will increase drastically.

2.10. Conceptual Framework

The focus and purpose of the conceptual framework is to use the research question that will be converted into meaningful concepts. The conceptual framework is linked to the explanation of how the research problem is intended to be carried out (Adom, Hussein & Joe, 2018). According to Antonenko (2014), it serves as the basis for interpreting and understanding the relationships across various ideas, concepts and variables in the study. The literature review assists in developing the conceptual framework.

The conceptual framework for this study focused on the variables, outcomes and the presumed relationship between one another. The outcome of transport optimisation is related to the outcomes of whether an organisation utilises paper-based or system-based process. Thereafter, the various measurable factors can be favourable or unfavourable depending on which process the organisation follows, ultimately linking back to transport optimisation. Based on the literature review, there are a number of optimisation challenges that are identified that many FMCG companies face. These challenges ultimately impact the way in which the

business performance and can determine the success or failure rate of the service level provided to customers. In the FMCG industry, customer expectations and demands are key and in order to meet these, the optimisation challenges cannot be left unresolved. Together with these challenges comes in the role of manual processes still used by many companies and the impact it can of the company's competitiveness and remaining within the industry trends. Some of these challenges include more time required for the routing and scheduling as human intervention is involved which can increase errors made, no traffic considerations take place, the use of intellectual knowledge such as maximum vehicle and load capacities, driver hours, shortest distance travelled and the most optimal route might not be fully considered, transport costs can be increased due to inefficiencies of route planning and driver behaviour, live tracking of deliveries might not be available and reduced customer service due to the lack of advancements available. The transport optimisation challenges and the challenges identified from using manual-based process are mostly the same and can therefore have a negative effect on the business.

The efforts and trends within the IS environment have grown and the benefits derived from using an IS has been substantial over the number of years as described in the literature review. Some of these benefits include increased delivery times, improved customer service, planned versus actual delivery schedules compared to identify improvements, increased vehicle utilisation and better route optimisation resulting in reduced transport costs and improved integration amongst the business. The aim of the study was to collect data that justifies these benefits in a number of companies as well as identify companies that are still using manual process and how that impacts transport optimisation. The relationship between manual and IS in this research was focused on justifying the use of IS in FMCG companies in order to improve transport optimisation challenges experienced.

The conceptual framework has been developed with the aim of highlighting both the transport optimisation challenges experienced without the use of IS and the challenges of manual-based processes. These will be used as the justification or reasoning behind the use of IS and the attempt in moving away from manual-based processes in the future. It is imperative for companies to consider various industry trends such as Supply Chain 4.0 and the future of digitalisation to improve the overall business process and ways on reducing costs. Information systems plays an important role in this and therefore, the framework also focuses on the benefits that can be derived from IS. Later in the study, other factors will be brought in such as the challenges and limitations of IS. The overall outcome of the framework and the research is determining whether IS can ultimately resolve or minimise challenges experienced with transport optimisation.

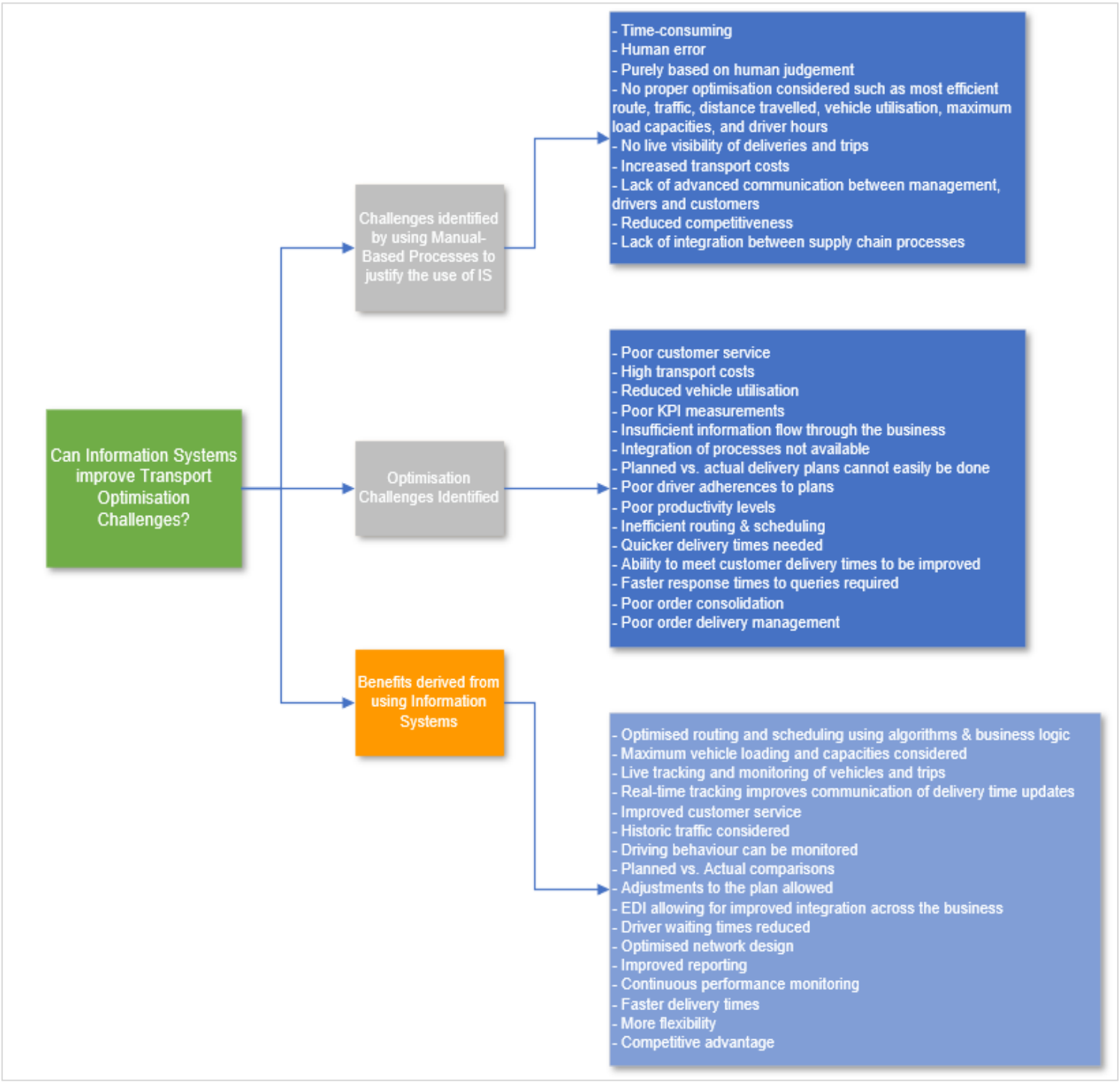


Figure 2-1. The Conceptual Framework (Developed by the author)

2.11. Summary of Literature Review

Based on the literature review, it is evident that supply chain management has evolved over the years and with this growth, the FMCG industry has been impacted in terms of optimisation issues and having to manage customer demands to faster delivery times. The FMCG industry handles high volumes but at fast turnaround times. Due to this, companies need to be able to have solutions and processes in place that promotes efficiency and effectiveness of the operation.

The key concepts derived from the literature review include the various transport optimisation issues identified. Based on the research, these can have a significant impact on the performance and success of the business such as the increasing fuel costs, high volumes of products, growth in customer demand and inefficient vehicle capacity utilisation levels.

Another concept identified was the impact of IS on FMCG companies. Research shows that IS can assist companies in reducing the issues experienced improving cost savings and customer service. Although this has been determined based on past research, it has also been identified that with IS solutions comes the importance of understanding the system functionality against the business requirements. If not properly managed, the consequences could be dire to the operation's success.

The future of IS within supply chain management is growing at a rapid rate and companies need to take full advantage of this in order to remain competitive. An example of this is the use of predictive shipping enabling quicker delivery times to customers used by Amazon.

CHAPTER 3

3. RESEARCH METHODS

This chapter is based on the methodology that was followed in order for the research to be conducted. As defined by Walliman (2011), research methods are the types of techniques that will be used to collect and analyse the data to conclude the research conducted. Research methods consists of two methodologies namely, quantitative and qualitative research (Williams, 2007). Quantitative research methods involve the use of numbers and measurable data through systematic processes to interpret and analyse the data, whereas qualitative research methods deal with gathering rich data based on gaining insights into people's reasoning and opinions on a specific matter (Daniel, 2016)

Glatthorn and Joyner (2005) explained that a research methodology involves two criteria that should be considered carefully. These include, having the most appropriate methodology in place to ensure that research objectives can be met and secondly, the methodology should be able to be replicated by other researchers.

As discussed in Chapter 1, the purpose of the study is to answer the research question which aims to understand how the adoption of IS impacts the road transport management in South African FMCG supply chains. Data was then collected to allow the researcher to conduct the study and answer the research question. This chapter addresses the following sections:

- Section 3.1: The Research Design
- Section 3.2: Instrumentation
- Section 3.3: Sampling
- Section 3.4: Data Collection Procedure
- Section 3.5: Data Analysis Procedure
- Section 3.6: Chi-Square Test
- Section 3.7: Reliability and Validity
- Section 3.8: Ethics Clearances/Issues
- Section 3.9: Summary of Research Methods

3.1. Research Design

According to Akhtar (2016), the research design is one of the most important elements of the study as it holds together the various elements of the research and proposes the plan that will be carried out to conduct the study.

During the planning of the research design, it was identified that data obtained from the survey which contained both Likert and open-ended questions, should be further validated by using historical KPI and transactional data obtained by a consulting company. Therefore, a mixed methods research was chosen for

this study. There are different types of mixed methods research designs where both qualitative and quantitative data are gathered either concurrently or sequentially (Public Health Training Center, 2017). Schoonenboom and Johnson (2017) explained that mixed methods research is essentially used to assist in the improvement of the overall knowledge and validity of the research. The reason for using this method was that there could be a risk from the qualitative data obtained where a percentage of the questionnaires are not properly completed, or the data is unreliable. The use of both methods ensured the reduction of the researcher's personal biases from the qualitative data alone and to obtain a more complete state of evidence enabling more in-depth research to be gained (Mahmood, 2017).

Mixed methods research involves the use of both qualitative and quantitative research when collecting and analysis data. The aim of mixed methods research is to use the strengths of one research method while minimising the weakness of the other method (Shorten & Smith, 2017). It also allows the researcher to gain a more comprehensive set of results as opposed to using only one research method. As per Appendix 1, both sets of data are collected, analysed and the results are obtained (Creswell, 2012). Once this has been completed, the results of both sets can then be compared and interpreted. This is referred to as concurrent triangulation which forms part of the research methodology that was followed for this study (Shorten & Smith, 2017).

As much as there are significant benefits from using a mixed methods research, there can be a few disadvantages and limitations associated with it (Wall, 2019). These limitations need to be considered to reduce the impacts thereof. Some of the weaknesses identified with concurrent triangulation in particular include the following:

- A great amount of effort is required by having to use two separate research methods concurrently.
- The two sets of results obtained from the data can become difficult to analyse as the datasets are two different forms of data.
- The data collection is conducted simultaneously which will mean that the data received cannot be combined as it forms part of two different sets of data.
- The data analysis can be time consuming as opposed to using one method as double the amount of time is required to analyse both datasets.

A great amount of time and effort had to be considered from the beginning and the impact it would place on the study due to two methods having to be collected and analysed. With the aim of mitigating any limitations or weaknesses of using a mixed methods research, the research ensured that sufficient time was allocated to each method's data collection and data analysis as this had to be connected simultaneously and separately from one another. Due to no research team being involved in this study, the researcher had to ensure that the questionnaire was prepared and ready for administering in time to avoid any delays while the historical data was being collected for the quantitative research. Therefore, the questionnaire was first developed, sent out for pilot testing and ready when the collection of the quantitative data collection had begun. This ensured that

both data collection methods took place concurrently in order to streamline the data analysis process when that had to begin and avoid any time delays of completing the research.

3.2. Instrumentation

With a mixed methods research being selected, both qualitative and quantitative research was conducted during the study.

3.2.1. Instrumentation: Qualitative Research Methods:

According to Mahmood (2017), a qualitative research design contains the understanding and interpretation of people's experiences. Qualitative research involves the collection and gathering of data through various methods such as questionnaires, interviews, observations and focus groups. Gubrium, J.F. et al. (2012) explained the various methods available for data collection. Interviews can be used to understand various experiences, views and opinions from people. These interviews can be based on structured, semi-structured or open and in-depth questions. The ability to study people's actions can be achieved through observational methods.

For this research, the data was collected through an online survey where a link to the questionnaire was sent out to the relevant respondents, see Appendix 3. Based on the literature review in Chapter 2 and the research question, the online survey was developed to identify current challenges experienced in different work environments and the impact of utilising IS within the transportation aspect of the supply chain.

3.2.1.1. Survey Research

Surveys are a form of data collection which enables the transmission of data from the respondents answering the questions to the researcher (Wilkinson and Birmingham, 2003). The goal of using survey research is to gain a better understanding of a population by administering a survey to a sample of the population (Leedy and Ormrod, 2016). The design process is critical as it will determine whether the analysis process is easy or not. Surveys can be difficult to design as the questions can be ambiguous to the respondent making it hard to properly understand what is required to be answered. Therefore, making the results inaccurate. Hence the importance of a properly managed design process for any survey developed (Wilkinson and Birmingham, 2003).

A survey that is designed correctly and executed will result in more accurate data received, making it easier for the researcher to analyse and interpret (Klazema, 2014). Hence, if managed properly, fewer resources will be required to carry out the survey research. Survey research can be conducted in several ways such as, telephonically, via email or mail, online, social media and conducted face-to-face (Klazema, 2014). Evans & Mathur (2005) described survey research as being conducted in three manners, telephonically, online or in person with online surveys being the most popular method considering the benefits obtained from it. These

benefits include online surveys being cost effective and result in highly accurate responses (Evans & Mathur, 2005).

The steps that are followed when using survey research include, understanding and considering the objectives of the study, identify the target participants that will be required to answer the questions, designing the survey, conducting a pilot test to ensure the questions can be answered without any ambiguity, administering the surveys and lastly, interpreting and analysing the results obtained (Kelley et al, 2003). Once the data has been received from respondents, the answers must be recorded, coded and analysed correctly in order to gain an accurate interpretation of all the opinions and views of the respondents (Klazema, 2014).

Benefits of Surveys

According to Wilkinson and Birmingham (2003), surveys can be designed to collect a large amount of data from respondents if designed and executed correctly. The benefits that can be derived from using surveys include, inexpensive to administer, little training is required to develop surveys, and it can be easily analysed and interpreted once received from respondents.

Limitations of Surveys

Although there are benefits in using surveys as a research instrument over others, there are certain limitations that can hamper the success of the data collection and analysis. To name a few, surveys are often used and can result in researchers competing for participant's time. If there is insufficient time allocated for the surveys to be completed, the result may be a significantly low response rate or invalid data received. If surveys are administered online or via email, the response rate can be low due to the lack of personal contact which leads to unnecessary time wastage of follow-up letters and telephone calls (Wilkinson and Birmingham, 2003).

Development of the Survey:

There are different types of questions that can assist when developing the survey in order to gain adequate data. Survey Monkey (2018) identified open-ended questions as a method where the respondent is allowed to express in-depth opinions on specific matters. Due to the questionnaire containing open-ended questions which allows respondents to provide perspectives on certain matters, qualitative survey research is possible (Survey Monkey, 2018). Likert scale survey questions are typically used when trying to measure the opinion of the respondent towards a specific subject and is based on a five-, seven- or nine-point scale (Question Pro, 2018). Likert scale questions provides a greater level of flexibility and accuracy in surveys (Wilkinson and Birmingham, 2003).

According to Bhat (2018), the process of creating questionnaires involves the following steps:

- Decide on the survey questions that will be asked. This is important as the questions need to be structured and worded in order to gain the most insight based on the research question and objectives.
- The types of questions are also important and must be considered. The researcher can use open-ended questions to gather rich data from respondents as well as make use of Likert scale and multiple-choice questions to have a fair mix of questions without making the questionnaire tedious.
- Once the targeted sample has been finalised, the medium to distribute the questionnaires must be determined. As discussed under section 3.2.1.1, there are various methods of administering the questionnaire which is important as it can affect the response rates.
- Pilot testing is the next step and is crucial to perform before the questionnaire is distributed to all the respondents. This will assist in determining if there are any errors or if any questions need to be changed.
- The questionnaires can then be distributed and once responses are received, the data can be analysed and interpret to conclude the data collected.

From the literature discussed above, the researcher chose to focus on the impact of the why and how of the study which was demonstrated through an online survey. Therefore, a questionnaire was developed to understand and gain data to be able to answer the research question. For this study, the questionnaire was created using Survey Monkey where the link was sent to the respondents via email together with a consent letter. There has been an increase in the use of questionnaires to be completed online. Wilkinson and Birmingham (2003) explained that some of the reasons for this is that online questionnaires are inexpensive, easy and quick to create and to distribute to a number of respondents.

Open-ended questions were formulated and the use of Likert scale questions where a 5 – point scale, ranging from strongly agree, agree, neutral, disagree to strongly disagree was added to one of the questions. The use of yes or no questions were also added to the questionnaire in an attempt to reduce the time of completing the questionnaire for the respondents which was followed by an open-ended question to elaborate on the yes or no answer provided. These types of questions were chosen as it both enabled the purpose of qualitative data to be collected and allowed the respondents to express opinions and reasoning for each question. The researcher kept the questions precise and ensured it was understandable to avoid incomplete questionnaires being returned.

When the questionnaire was created, the aim was to ensure that each question is structured in a logical manner and easy to use and understand what is required. The questionnaire was developed based on a conceptual framework which took into consideration the research question and what is intended to be achieved through the research. The conceptual framework was also based on various concepts relating to the literature review which was discussed in more detail in Chapter 2. The main framework for this study was to investigate the various transport optimisation issues and whether IS can address these challenges. Hence, the questionnaire was developed and split into two sections. Section one contained information regarding the participant's work

details such as job title and role and the second section displayed the list of questions. The questions were developed based on the required data needed to answer the research question.

The focus on the structure of the online questionnaire was developed to enable the respondent to have a subjective view to elicit facts and statements of the respondent's experience of IS in supply chain management within the FMCG industry. The formation of the questions focused on obtaining information from the respondent's work environment and current occurrences taking place in the industry. Certain questions were developed to identify the current trends of the study by identifying what people's thoughts were of IS in supply chains as well as the future of it. Hence, the use of purposive sampling due to the specific data required for this study. The researcher ensured the questions followed one another in a logical and systematic manner. This was achieved by structuring the questions so that the leading question was a follow up question from the previous one.

The questionnaire consisted of 10 questions which involved detailed word answers as well as numerical value answers through the use of Likert scaling. All numerical answers were calculated, and the results was based according to the level of agreement for each numerical question. All other questions were summarised based on common groupings and themes. All respondents and company names were kept anonymous for the purpose of the study.

The front page of the questionnaire was used as the cover letter but to also explain the purpose of the research and briefly provide information on the research. The cover letter was formulated to ensure the relevant permission was granted by the respondent before the online questionnaire was completed (See Appendix 2). The cover letter provided the respondent with information about the research and allowed the respondent to give permission to the researcher to use the data received. According to Wilkinson and Birmingham (2003), cover letters should be kept precise and explain exactly the purpose of the study and the expectations. The researcher ensured that the questionnaire was explained properly to allow respondents to understand the purpose of the research. The consent letter clearly highlighted that all data obtained from the questionnaires will be kept anonymously.

Each question was carefully thought through in order to gain as much data required to answer the research question. Please refer to Appendix 3 for the questionnaire. Question 1 of the survey was developed to get a sense of the industries each respondent worked within and the role played within the organisation. This helped in placing each respondent's data within either the FMCG, IS or supply chain industry and further categorised by role. Question 2 required the respondent to describe the current transport operation which allowed the researcher to understand what the current systems and processes were being used within the different respondent's work environment. This was the starting point to understand what the current process of the business was. Question 3 was developed with the aim of then understanding what the transport optimisation challenges were and if there were any current measures in place to improve the optimisation. A big part of

the study was to identify various transport optimisation challenges and whether IS can assist in reducing the challenges identified. Hence, the need for this question. Question 4 was used to identify whether any IS has been implemented and the benefits of the transport system thereof. This was an important question in the study as it formed the main part of understanding the percentage of companies currently using systems and if benefits were being derived.

The next three questions asked were in relation to question 4 if the respondents answered yes to having an IS in place. Question 5 was aimed at then understanding whether any disadvantages were experienced from the implementation of the IS. This was also key as it allowed the researcher to not only know the benefits received in question 4 but to get a sense of the negatives of using an IS. The data needed from question 6 was to understand the types of processes in place prior to the IS implementation. The aim of this question was to comprehend the different processes used and which had more benefit towards the optimisation of transport. Question 7 was asked to gain data of whether the current IS implemented improved the challenges experienced which was important to make sense of whether IS actually assisted the business with challenges. Question 8 was for the respondents that answered no to question 4 and to know whether the company considered implementing a system. Question 9 then followed which was to understand if a manual process in place had many associated challenges. The last question was to get a rating of how the respondents thought IS can reduce challenged faced with transport optimisation.

Based on the conceptual framework, questions 3, 5, 6, 8 and 9 were developed to identify the challenges identified from using manual-based processes as well as identifying transport optimisation issues. Questions 4, 7 and 10 were developed to identify the benefits derived from using information systems. Question 1 and 2 were developed to understand the roles within the industry that took part and the current transport operations. All the questions developed were aimed at the ability of answering the research question and objectives of the study.

3.2.2. Instrumentation: Quantitative Research Methods:

Often, data collected for quantitative research involve surveys being conducted by a large number of respondents, however, the use of secondary data such as census data or historical data can be used to obtain results (Crossman, 2018).

Secondary data involves the use of data that already exists from sources such as the internet, government, research reports or libraries (Surendran, 2019). For the purpose of this study, the researcher made use of secondary data that was obtained during an implementation project conducted by a consulting company. The historical KPI and transactional data was then analysed and interpreted by the researcher. The KPI data included route plan adherence which measured how the scheduled planned trips were being adhered to by the drivers and the average vehicle utilisation which measured the utilisation of all the vehicles per month. The

transactional data included the total number of shipments delivered per month, total number of vehicles utilised per month and the total costs per month.

Strengths of Quantitative Research:

Daniel (2016) described one of the strengths as the ability to summarise a number of information sources in order to make comparisons. Bhatia (2018) explained that quantitative research can provide conclusive answers to the research question and once the data has been collected and analysed according to a proper methodology, the results can be trustworthy. In addition, Surendran (2019) explained that due to numerical data being gathered, the results will be more accurate and therefore, trustworthy. Another strength stated by Bhatia (2018) is that the results obtained from a sample can be generalised to the entire population. The elimination of personal biases can be achieved due to the numerical results being obtained (Surendran, 2019).

Limitations of Quantitative Research:

According to Bhatia (2018), using quantitative research has certain limitations. These include people's thoughts and perceptions not being taken into account and the why and how of the research is not consider when evaluating the research problem. The data obtained may not be robust enough to explore and understand more complex issues.

3.3. Sampling

The target population for this study was selected from various road transport, IS and FMCG companies within the Johannesburg region. It included various respondents, such as operations managers, analysts, system implementers, engineers and solution developers.

Purposive sampling which is also known as selective or subjective sampling is defined as a sampling method in which the population for the study is chosen based on the researcher's judgement (Etikan, 2016). This sampling method is a non-probability method and is often chosen due to the specific nature of the research question and objectives (Crossman, 2019).

For this reason, a purposive sampling method was used where the total population with specific expertise within the IS and supply chain industry were given the questionnaire to complete within the FMCG industry. This method was selected due to the specific expertise required to conduct a thorough analysis of the data received. There are different types of purposive sampling and the decision was made to select expert sampling due to the specific characteristics of the sample that was required for the data collection. Expert sampling is used when data is required to be obtained from a specific form of expertise (Crossman, 2018). This sampling method assisted in becoming more informed and understanding the study on hand.

According to Shukairy (2019), it is important to note that for qualitative data, the quality of the responses is much more important and hold more value in data collection and analysis than the quantity of responses. The

sample size for the study was 20 respondents to ensure that sufficient and accurate data was received for the qualitative research method. Survey Monkey (2018) described a sample size as the number of completed questionnaires that have been received. This involved a population exposed to transport management, IS and the FMCG industry. The respondents were selected based on the nature of work and industry as well as having been exposed to IS and transport operations in the supply chain and FMCG industry. This formed part of conducting the expert sampling. There was a total of 14 questionnaires that were received fully completed. One questionnaire was received as incomplete and therefore was not included in the data analysis. The response rate for the questionnaire calculated to 65% as the number of responses required were 20. This was calculated by dividing the number of responses by the number of questionnaires distributed (Ramshaw, 2017). The level of significance for this is interpreted in Chapter 4. The accepted confidence level of 95% and p-value of 0.05 was used. According to Fryrear (2015), a response rate ranging between 10% to 30% will be typically achieved for external surveys depending on the engagement of the sample. Internal surveys usually receive between 30% to 40% response rate whereas external surveys tend to have a much lower rate due to the population (Fryrear, 2015).

For the quantitative research, a company that currently has implemented a TMS has been used where KPI and transactional data was collected to further validate the results found from the qualitative research. The KPI data included route plan adherence which measured how the scheduled planned trips were being adhered to by the drivers and the average vehicle utilisation which measured the utilisation of all the vehicles per month. The transactional data included the total number of shipments delivered per month, total number of vehicles utilised per month and the total costs per month. The data received for the quantitative research was detailed and sufficient to provide the researcher with the necessary and in-depth analysis required to answer the research question. Hence, due to the detailed data set from the consulting company for the quantitative research analysis, the 65% response rate was sufficient to complete a thorough analysis and obtain accurate results.

3.4. Data Collection Procedure

Data collection is critical to ensure the research is conducted in a systematic manner and assists the researcher in answering the research question based on the information gathered (Kelley et al, 2003). Jovancic (2019) described data collection as the process of data gathering and analysis in a systematic manner based on the research methodology defined with the aim of answering the research question and objectives. Gill, Stewart & Treasure (2008) explained that data collection involves collecting and analysing data using validated techniques and is considered the most important step to conduct the research and achieve the research objectives.

For the purpose of this research, as discussed earlier, it was decided that online questionnaires would be used to collect the qualitative data and historical secondary data would be used to provide the quantitative information.

3.4.1. Concurrent Triangulation:

Triangulation aims is to establish a comparison of the findings from both the qualitative and quantitative data collection to ensure validity of the results (Public Health Training Center, 2017). The process is initiated with the formulation of a research question that is studied using both methods where the data is collected within the same time frame hence the name concurrent triangulation (Public Health Training Center, 2017). According to Castro, Kellison & Kopak (2010), the two methods are utilised to confirm or cross-validate the findings to overcome the weakness from one method with the strengths of another, therefore making the data collection concurrent.

The strategies that are used for data collection involves the validation of one set of data with another set. This validation then enables the researcher to compare both sets of data to gain the appropriate results required to answer the research question. Mixed methods involve at least one point of integration where the qualitative and quantitative data are combined at some point in the study at which point the two sets of data are mixed (Schoonenboom and Johnson, 2017). For this study, the data was collected simultaneously, analysed and the results were then combined and compared to one another. The results of both qualitative and quantitative research methods were compared during the discussion and interpretation of the study.

Based on the selection of the concurrent triangulation method, this research method was chosen to gain a broader perspective and better understanding of the findings. One data resource may not be sufficient to explain the initial findings, hence a secondary data method can be used to enhance the primary method (Castro, Kellison & Kopak, 2010). The quantitative data in this study provided the necessary support required to draw general conclusions from the findings to support the findings of the qualitative research (Survey Monkey, 2018).

Some of the advantages of using triangulation include collection and analysis of data in a single phase, a more valid result set where both the qualitative and quantitative data can provide results to answer the research question and the ability to draw the strengths of the data methods to overcome the weaknesses.

With the above being mentioned, both data collection methods will be discussed further in Sections 3.4.2. and 3.4.3. to explain the process of how the data was collected concurrently.

3.4.2. Qualitative Research Data Collection

Survey research for qualitative data collection is used to gather detailed data based on the opinions and reasons from an individual's perspective (Survey Monkey, 2018). The reasons for using questionnaires were due to time and cost constraints, the efficiency of questionnaires to manage and distribute, the ease of analysing the data received and to ensure anonymity among the respondents.

3.4.2.1. Development of the Questionnaire

As described by Farrell (2016), qualitative surveys are structured in a manner to allow respondents to provide comments, feedback and suggestions that enable rich data to be gained rather than quantitative surveys where numbers can be tallied. Debois (2019) described surveys as the process of accumulating data that involves data collection methods such as questionnaires. Qualitative surveys are generally used to collect data based on different types of questions such as opened-ended questions, multiple choices as well as the use of the Likert scale (Wilkinson and Birmingham, 2003).

The development of the survey for the qualitative data collection has been described in section 3.2.1.1.

3.4.2.2. Administering the Questionnaire

Electronic administration of questionnaires is the most feasible and practical method to distribute and collect survey research (Hassler, Pearce & Serfass, 2018). The use of online questionnaires enables the respondents to think more and be able to provide more accurate data rather than face-to-face interviews where the respondent could feel under pressure to provide quicker responses (Kelley et al, 2003).

The researcher chose to administer the questionnaires without any assistance from a research team. This was completed through the use of online platforms, such as emails and social networks. Once the questionnaire was created on Survey Monkey, a link was generated which was then used to email respondents. The email that was distributed contained a brief explanation of the purpose of the research as well as an explanation that all data received will be kept confidential which was an important factor. According to Kaiser (2009), assurance of confidentiality is a key aspect in increasing the response rate. The researcher also decided to post the questionnaire link on social networks to increase the response rate.

A follow up email was sent to respondents for questionnaires that were not received back within a certain time period. The respondents were given a four-week period to complete the surveys. This decision was taken to ensure sufficient time was provided.

3.4.2.3. Pilot Testing of the Questionnaire

Designing a questionnaire can often lead to misunderstood questions or ambiguity resulting in respondents not answering questions correctly. There could also be mistakes within the questionnaire that could easily be overlooked by the researcher. With these issues in mind, piloting the questionnaire before it is administered to the targeted sample is crucial in ensuring the data collection and analysis process leads to a more accurate set of results (Wilkinson and Birmingham, 2003). The need for a pre-test and pilot of the questionnaire generated is essential as it will help in identifying questions that do not make sense or any other problems that could result in respondents being biased when answering any questions (Hilton, 2015).

The questionnaire was tested twice before releasing it to a small sample group of five individuals to ensure all questions could be answered and saved without any issues occurring. This also assisted in determining the duration of the questionnaire and the willingness to complete all questions or if any questions were not understandable or was not user-friendly. The five individuals were selected based on the industry and expertise in order to easily understand the questionnaire and assist in equally identifying any issues and uncertainties with the questionnaire. Wilkinson and Birmingham (2003) further explained that during the pilot test, it can be easily identified if the questionnaire takes too long to complete and therefore omitted or edited specific questions can be achieved.

The testing of the questionnaire was completed, identifying the need to change the last question as the sample could not save the questionnaire once completed. This data was then analysed to ensure all answers could be viewed and validated. The last question was altered, and the researcher then tested the questionnaire twice to ensure no questions could not be answered or any errors occurred. The resulting online questionnaire was sent out to individuals in FMCG and supply chain companies as well as individuals working within the supply chain IS environment.

3.4.3. Quantitative Research Data Collection

According to Ali & Bhaskar (2016), the quantitative data involves close-ended information that includes statistical analysis and formulates numerical findings. The data collection methods involved in quantitative research includes methods such as interviews which are much more structured as opposed to qualitative research and can be conducted telephonically or in person (Question Pro, 2018). Another method is the use of surveys that contain closed-ended questions and can be done online or via email. Observations are also a form of data collection where the researcher will gather data through a systematic observation of a study. Lastly, document review is a quantitative research data collection which is the process of reviewing existing data that can be collected from various sources namely, public records such as annual reports, personal documents and physical evidence known as secondary data (Question Pro, 2018).

In terms of the quantitative research method, the researcher contacted a consulting company that was able to provide historical secondary data within the FMCG industry. The data was based on historical KPI and transactional data to compare the company's performance before and after the IS implementation in terms of overall cost and vehicle reductions. The purpose and rationale for using the historical data was to identify if and how IS can assist in the reduction and improvement of transport optimisation issues. This data assisted in identifying business improvement strategies on how IS can be used within an organisation as recommendations for future implementations. In order to obtain and utilise this data, a consent letter was used to ensure all confidentiality was adhered to. This can be found in Appendix 4.

3.5. Data Analysis Procedure

Once the data was collected, the data preparation process was conducted. According to Bhatia (2018), data preparation is an important step in the data analysis process to ensure the data is manageable for analysis.

Ali & Bhaskar (2016) explained that once the data was collected, the results involves both observations and statistical analysis. This will ensure validity as additional evidence and support are provided for the data analysis and interpretation. According to Ali & Bhaskar (2016), mixed methods includes both inductive and deductive thinking and enables the researcher to use wording and numerical analysis to facilitate the results. There are two types of data analysis methods. One being descriptive statistics which describes the data and the other being inferential statistics which allows the researcher to make predictions based on the data found.

For the purpose of this study, descriptive statistics was used for both research methods. The use of descriptive analysis was used to create statistics based on the findings to validate the research question. Seeing purposive sampling was selected, descriptive analysis was the most beneficial analysis technique as it described and measured all subject matter experts in the group. The findings gathered from the sample selected was recorded and summary statistics and graphs were then used to present the findings of the sample using both words and numbers.

Descriptive statistics is used to summarise and graph the data for the sample selected and allow for a better understanding of the specific set of observations to be gained (Frost, 2018). Frost explained that there are different tools that can be used to describe the data, such as central tendency, which uses the mean or median to locate the centre of the dataset. The other tool is dispersion which involves using the range or standard deviation to measure how far out the dataset extends from the centre. A low dispersion represents a tighter cluster around the centre of the dataset and a high dispersion indicates that the values fall further away from the centre (Frost, 2018). The interpretation will then involve the comparison or combination of findings from both research methods (Public Health Training Center, 2017). Bhatia (2018) further explained that other types of descriptive analysis includes the use of the mean, median, mode, percentage, frequency and range of the data. For the purpose of this study, frequency tables were used to analyse the data where the frequency, relative frequency and percentage per data set were calculated. According to ER Services (2017), frequency distribution involves a summary of the frequency or percentages of the number of occurrences of the grouped data.

3.5.1. Qualitative Research Data Analysis:

The analysis of qualitative data is done differently from that of quantitative data analysis, in the sense that qualitative data is made up of words and observations (Bhatia, 2018). A thorough analysis was completed on all questionnaires to assess the validity of the answers. Coding was used for the questionnaire responses. Coding in qualitative data analysis is important as themes are determined during this process and involves assigning labels to questionnaire responses that hold meaning (Pierre & Jackson, 2014). Farrell (2016)

explained that during qualitative data analysis, coding involves the process of taking the open-ended data gained and turning the data into code that can be counted in order to extract similar phrases or categories to report on. The use of content analysis for the qualitative data was used which is aimed at a systematic data analysis so that generalisations can be made in relation to common categories (Haggart, 2009).

The data from each question was reviewed thoroughly and was then sorted, organised and clustered into specific groups in order to make the data more understandable. The grouped data were completed based on identifying common answers and patterns among all the responses. Bhatia (2018) explained that the most common way to identify common groups when coding is known as word-based method which uses word repetitions to quickly identify patterns that can be grouped. Each category based on the data received per question was assigned numerical values in order to calculate the frequency and percentage per category in order to retrieve constructive data from the source. Once the data was coded, the grouped data was then added onto graphs and tables to visually display the coding that was completed.

As mentioned in section 3.2.1.1, the design of the questionnaire was developed with certain questions being related to one another and how each question was important for the data collection. Questions 4 to 7 were formulated specifically for those respondent's that have an IS implemented and being used within the organisation. This assisted in developing the analysis to understand the number of total respondents that currently use an IS and the associated benefits and challenges. All the questions were aimed at gaining adequate data required to be able to answer the research question.

3.5.2. Quantitative Research Data Analysis:

With regards to the quantitative data, the KPI and transactional data received from the consulting company that was used for this study was analysed through descriptive analysis to address the research question.

The historical FMCG company data that was received from the consulting company was for six months prior to implementation and 20 months after implementation. For a proper data analysis and comparison for the study, six months of data prior to go-live and six to twelve months of data after go-live of the system was used. The reason for using only the first six months of data after go-live for the data analysis instead of the full 20 months was to ensure a proper comparison was done before and after the system was implemented. The data received was historical KPI and transactional data based on the number of shipments that were delivered on a daily basis before and after the system was implemented. The transactional data also showed the various costs involved in the delivery of orders. This data was then clustered into months to give a high-level overview of the occurrence monthly.

The data was broken down into different sections to assist the researcher in an accurate analysis and interpretation. The researcher firstly organised the data into more manageable sets to fully comprehend the numerical data. It was decided to only use twelve months of data after the implementation to manage the

analysis when doing the comparison of the data before implementation. It also allowed for a more accurate view of the results. The data was then grouped through the use of excel pivot tables and graphs to analyse each section of the data as well as summarising the main data into a summary table to give a high-level overview of the results. These groups of data were broken into costs, vehicle utilisation, the number of vehicles and the adherence to the use of the system by employees.

The use of mixed methods research allowed the results to be combined and then compared in order to improve the validity and accuracy of the findings. This assisted in the comparison of the processes used prior the implementation and after implementation to truly identify the impacts of IS to address transport optimisation issues.

3.6. Chi-Square Test

Chi-square test is used to measure the level of statistical significance between the observed and expected values. It assists with understanding the relation and association between two variables (Malhotra & Birks, 2006). These two variables are related to categories hence this statistical method was chosen (Frankie, Ho & Christie, 2011). The variables measured contained numerical data as well as categories of the coded data based on the surveys. The purpose of this method is to also test the hypothesis and whether there is independence between the variables (Rana & Singhal, 2015).

The null hypothesis states that there is no significance between the variables. With the chi-square test, the use of alpha is also required which is set at 5% (0.05) as an acceptable rate. Critical to hypothesis testing is the probability of finding the sample result if the null hypothesis is true which is referred to as the p value. If the p value is lower than the alpha of 5%, then the null hypothesis is rejected, meaning the data is statistically significant. If the p value is greater than the 5% then the null hypothesis is retained, meaning the data is not statistically significant (Chiang, Jhangiani & Price, 2015).

3.7. Reliability and Validity

The reliability and validity of research is important as it measures the quality of the data collected. Reliability refers to the consistency or repeatability of a method measuring something (Sauro, 2015). The measurement will be considered reliable if the same results can be achieved by using the same methods. Validity refers to the accuracy of the intended measurement (Middleton, 2019).

Silverman (2004) explained that the data found must be reliable and the report formulated should be as accurate as possible. Frambach, J.M. et al. (2013) indicated that subject matter experts should be selected during data collection as this will ensure credibility of responses provided by respondents which will result in credible interpretation.

3.7.1. Reliability:

A chi-square test was conducted to measure the relationship between the variables. This assisted in determining the level of significance. The result set should remain consist after repeating the tests (Price & Jhangiani, 2019).

In terms of the dependability of the data, an established audit trail was kept of all the questionnaires and any other communication with respondents. This was kept under the researcher's account on Survey Monkey. The coding that was performed for the qualitative data was stored safely as a manner to refer back to it or have it readily available if needed. The conceptual framework was also used to assist with the consistency of the data based on Chapter 2 and the respondent's feedback on the surveys as seen in Figure 2-1. The use of online questionnaires prevented the researcher from influencing the respondent's answers that could have happened during face-to-face interviews.

3.7.2. Validity:

All notes and other documents used have been retained in order to have a complete record of the research and findings. The accuracy of the data was crucial to ensure the research was replicable and can be repeated. The precision of the data interpretation was also essential to ensure credibility of the study. Therefore, any documents used has been interpreted and analysed in the most accurate manner, avoiding any personal biases to ensure the research can be repeated and is valid. All observations were kept separately from the actual data found in the questionnaires and company data. This was to ensure there were no personal biases or any assumptions made based on personal interpretations on what the researcher thought the data should reflect.

3.7.2.1. Internal Validity:

The pre-test was also conducted for the questionnaire to ensure all questions were correct which allowed the respondents to be able to answer the questions without experiencing any issues. Instructions were also provided as part of the questionnaire which made it easily understandable for the respondents. The questions were kept simple and short enough to enhance the response rate.

3.7.2.2. External Validity:

Triangulation was used to ensure the credibility of the data by making use of different sources of past research and data found in Chapter 2. The qualitative data was further validated through the use of the quantitative data collected which aided to the credibility of the data used. It improved the validity and reliability of the research as it controlled the bias of the researcher by combining both findings to use the strengths of one method to improve the weakness of the other.

3.8. Ethical Issues/Clearance

Due to mixed methods research used, there was specific consent and privacy of information that required strict adherence. Hence, an ethics clearance was obtained through the School ethics committee. The ethics clearance number for the research report is MIAEC 122/18.

A consent letter was sent to the consulting company providing the FMCG company data that was used for the quantitative method to give consent to use the data in the research. For the qualitative method, a cover letter was used and was based as a front page of the online questionnaires which provided an overview and purpose of the study to the respondent as well as served as a consent letter. Both letters ensured the anonymity of all data received.

All data received was kept in a secure cloud software that is password protected and only accessible by the researcher. Once the research report is completed, it will be readily available to any of the respondents as well as the consulting company that provided the FMCG company data.

3.9. Summary of the Research Methodology

This chapter described the process of which the research methodology was formulated and carried out in detail. The research involved a mixed methods research where both qualitative and quantitative research methods were used. The decision for this was to ensure that the weaknesses of one method was strengthened by the other method. The researcher chose to use both to ensure the qualitative results can be validated by actual historic quantitative data.

Triangulation was chosen whereby the two sets of data was collected concurrently and thereafter analysed by comparing the data to one another to perform a cross-validation. The qualitative research method involved the use of online surveys to collect data where the questionnaire was created using Survey Monkey and distributed via email and social network platforms. The data was then analysed using coding. The quantitative research method followed the use of historic data which was provided to the researcher through a consulting company that implemented an IS solution to an FMCG company. The data was analysed through the use of data grouping based on numerical categories.

The chapter also included the sample size and the response rate for the qualitative survey research. It also explained the reliability and validity of the research and finally the ethical clearance that was required to conduct the research.

CHAPTER 4

4. DATA ANALYSIS AND RESULTS

This chapter is focused on the analysis and results of the data received for the study. The analysis and results will take into account the research question and objectives to gain an insight and in-depth understanding of the study on hand.

4.1. Analysis of the Survey:

The response rate for the surveys was not as expected and after numerous follow ups and requests were sent to both individuals as well as FMCG companies in South Africa to complete the questionnaire, a total of 13 completed questionnaires were collected out of the initial 20 responses required based on the sample size. Therefore, achieving a response rate of 65% for the qualitative research method. Taking into account that 20 responses were required, the 13 surveys collected were fully completed with detailed data. The analysis of the questionnaire can be found in various tables for each question in Appendix 5.

The analysis and results were split between the two research methods and then discussed into one combined section in Chapter 5. For the purpose of this Chapter, the qualitative results demonstrated the opinions of the respondents in terms of the research question of the study and the quantitative results demonstrated the statistics and values of a company that has implemented an IS to address transport optimisation issues. Therefore, the results identified whether or not the IS was successful for this company and whether the research question can be answered. The quantitative results were used to enhance the results of the surveys as discussed in Chapter 3.

Each question has been broken down and discussed based on the analysis and results. For the purpose of the data analysis of the qualitative data, content analysis was used as discussed in section 3.5, Chapter 3 where the data was coded and categorised and then added to frequency tables.

4.1.1. Question 1: Participant Information

Question 1 was an open-ended question which was based on information regarding job roles and regions in which each respondent was based. The result of this question is shown in Table 4-1 in Appendix 5.

Based on the data received within the FMCG industry, the participant information was split into different job roles. This assisted in identifying the different role players within the industry as well as the views of the study on hand from different aspects of businesses. It was important to obtain data that was not one-sided or biased, hence having viewpoints from different business units assisted in viable data in order to fully understanding the research.

The job roles identified from the questionnaire included, implementation, operations, analysis, engineering and solutions development, see Figure 4-1 below. The highest number of respondents was involved in business analysis with 31% followed by implementation and operations at 23% each. These categories made up the top three at 77% of the responses. Based on the role played in the business, the respondents should have a comprehensive understanding of business processes and any challenges experienced.

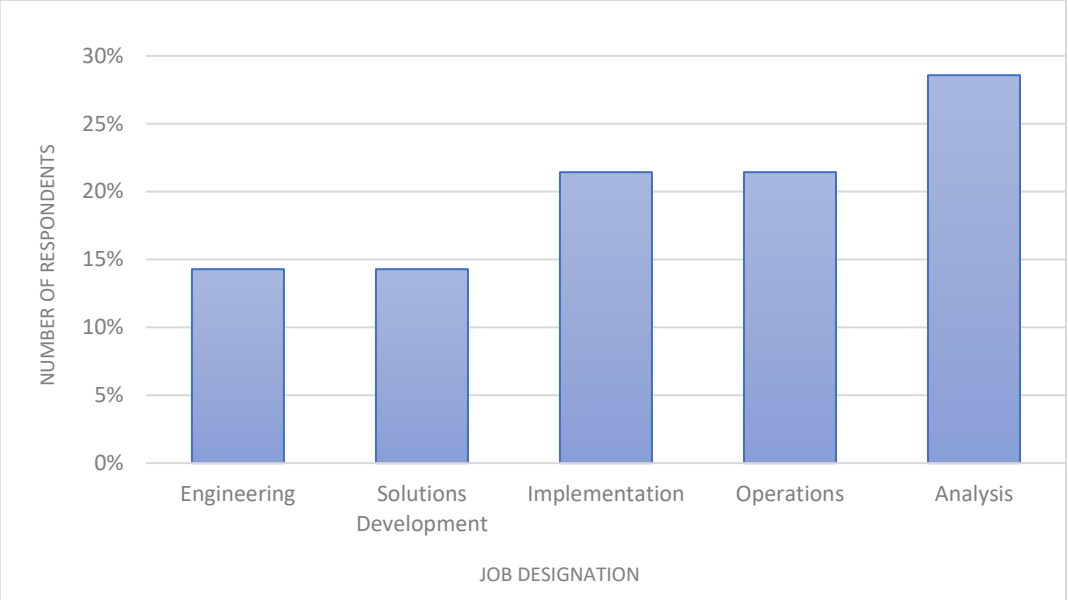


Figure 4- 1 Graph displaying the number of respondents per job designation (%)

4.1.2. Question 2: Describe how the current transport operation works in your organisation.

Question 2 was an open-ended question that allowed each respondent to freely describe the current transport operation. The results of this question are shown in Table 4-2 in Appendix 5.

The analysis for this question involved grouping the responses into 3 categories to identify the manner in which the operation is conducted. The categories were split into manual or system-based processes and lastly, undefinable. The undefinable category was chosen because the data received did not define whether the current operation involved any system or paper-based management at this stage of the data. Based on the questionnaires received, the description of current transport operations was also summarised to identify the common aspects of different businesses within the FMCG industry.

From the data received, it was evident that some sort of transport planning for daily deliveries to customers were an essential aspect to all the business operations involved. The operation involves daily deliveries to customers as well as stores and other warehouses of which are completed either through the use of owned vehicles or contracted and ad-hoc vehicles. 8% of the responses for this question was based around an element of manual work in the daily transport operation. Many organisations, based on the responses, are in involved in transport planning for next day delivery using a paper-based process such as excel.

31% of the answers received were based on an automated IS that is being used to manage daily transport operations. This is demonstrated in Figure 4-2 below. A summary of the respondents that currently have a system in place involved the daily planning of loads, delivery and execution of those loads and finally tracking the orders using a track and trace system. One of the respondents mentioned that although there are systems in place that caters for the different business units, there is no unity in terms of bringing those systems into one. Therefore, all units are working in silo's rather than finding ways to collaborate through the use of one system as a turnkey solution for the business.

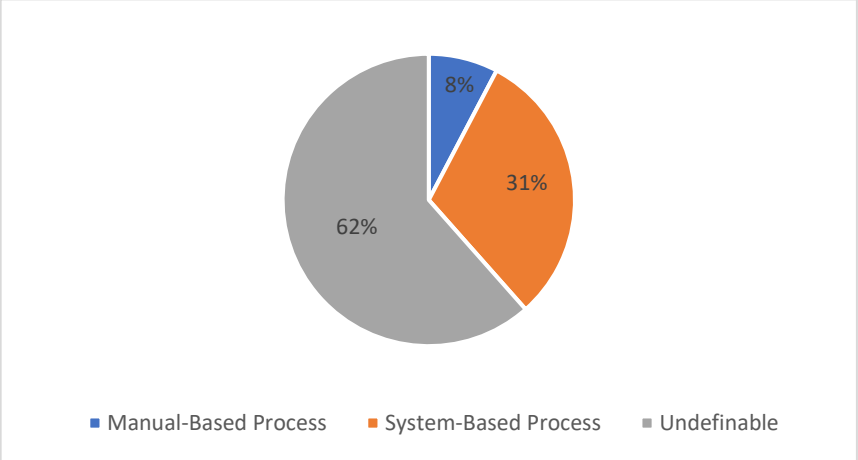


Figure 4- 2 Graph displaying the split between operational processes (%)

The chi-square statistics (X^2) was calculated for the above question. The X^2 of 5.69 indicates a p-value of 0.058 which is greater than the accepted significance level of 0.05. The degree of freedom (Df) calculated to 2. Therefore, the results indicate the variables are not statistically significant at a 95% confidence level.

4.1.3. Question 3: What are some of the challenges experienced with the optimisation of transport and what are some of the measures in place to resolve these challenges?

Question 3 was an open-ended question that allowed each respondent to explain the challenges that have been experienced with optimising the transport management within the supply chain. The question also allowed the respondents to describe the measures that have been put into place to address these challenges. The results of this question are shown in Table 4-3 in Appendix 5.

The data for this section was coded and then grouped into various categories based on the responses received. Based on this categories, the top three identified included, manual route planning, increase in fuel cost and poor order delivery management displayed in Figure 4-3 below. Route planning was the highest ranked challenge at 22% of the total list. The data identified that this was due to the issue of route planning taking place as a manual-based process where an element of human involvement has been included. The duration taken to complete daily route planning was also included as a challenge experienced which was linked to the human involvement.

Poor order delivery management was ranked in the top three at 19% due to incorrect orders being delivered. This category also included the high amounts of volumes not being properly split amongst the available transporters leading to poor on-time deliveries. It also involved delivering small parcels to the same area multiple times a day leading to an increase in fuel cost as well. An increase in fuel cost was listed as the second highest challenge with a ranking of 19% which tied back to all the other challenges such as route planning, order delivery management, consolidation of orders, and inefficient network design. Inefficient network design was listed as a challenge as the respondent mentioned that there are too many trips going out too often to outlying areas.

Other issues included the poor consolidation of orders to the correct area groups where orders were being delivered to the incorrect area resulting in routing problems.

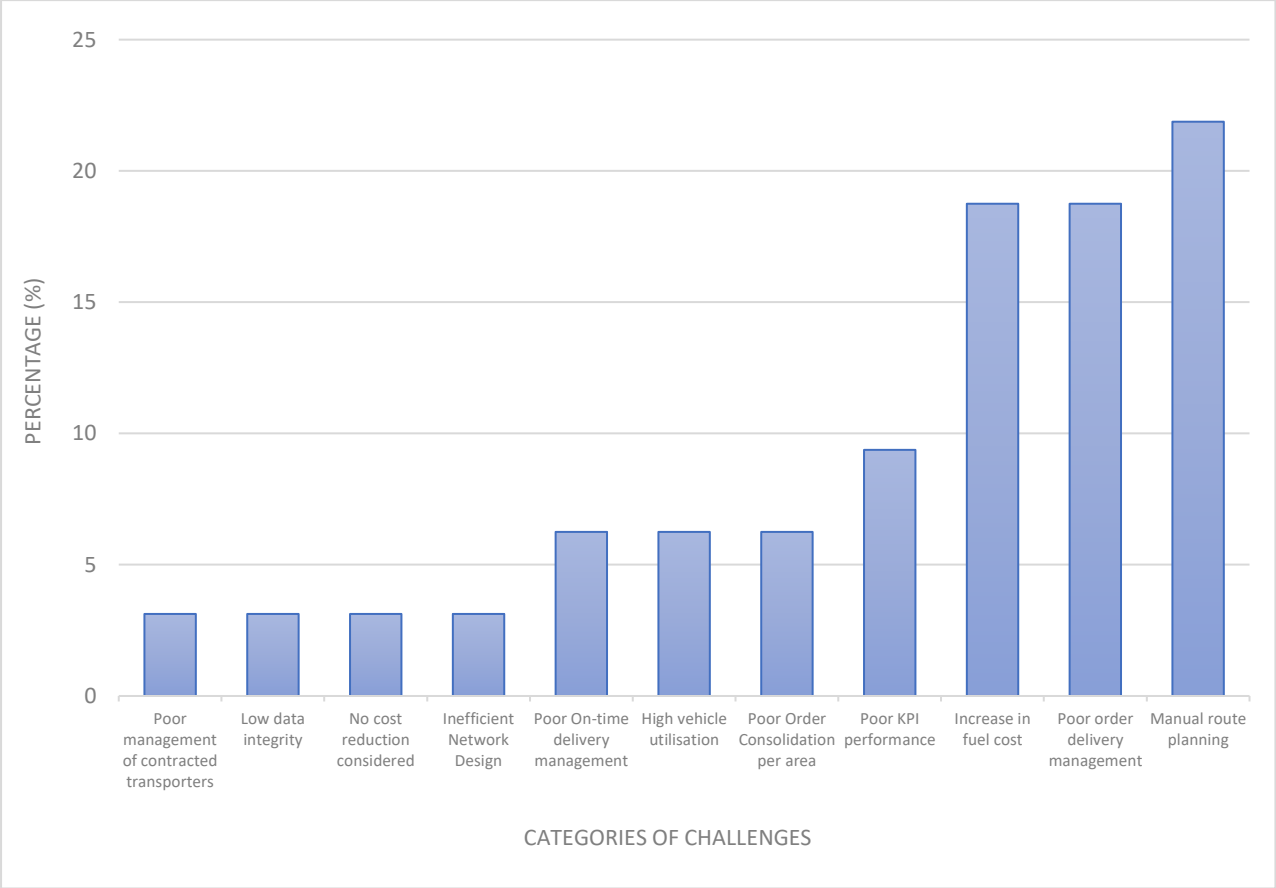


Figure 4- 3 Graph displaying the transport optimisation challenges (%)

The chi-square statistics (X^2) was calculated for the above question. The X^2 of 18.19 indicates a p-value of 0.0518 which is greater than the accepted significance level of 0.05. The degree of freedom (Df) calculated to 10. Therefore, the results indicate the variables are not statistically significant at a 95% confidence level.

4.1.4. Question 4: Information Systems Utilised

This section involved a closed-ended question to determine whether manual-based processes or systems are currently being utilised within the organisation, followed by two open-ended questions requesting the respondent to describe the type and purpose of the system as well as the benefits derived from the system. The result of this question is shown in Table 4-4 and Table 4-5 in Appendix 5.

4.1.4.1. Are there any systems in place in the transport division? How would you describe the type and purpose of the system in place? What are the benefits that the transport system has provided?

Based on Figure 4-4 below, it was found that there is a clear split between whether the companies that the respondents work for have a form of IS implemented or whether it is a manual process being followed. Based on the analysis, 69% of respondents have said there is a system in use within the business and 31% said there is still a manual process being followed. Figure 4-5 below demonstrates the different benefits that were provided by respondents based on transport systems in place. These benefits have been derived based on the different IS that each respondent's business has in place and forms part of a general basis of benefits across the use of IS.

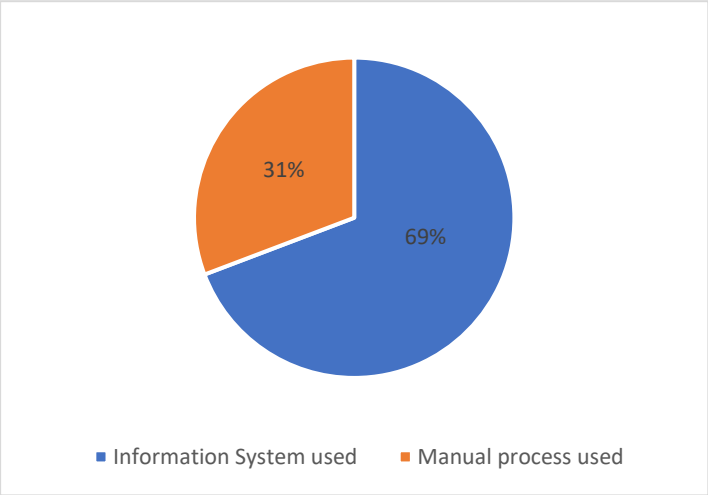


Figure 4- 4 Graph displaying the split between manual process and IS used (%)

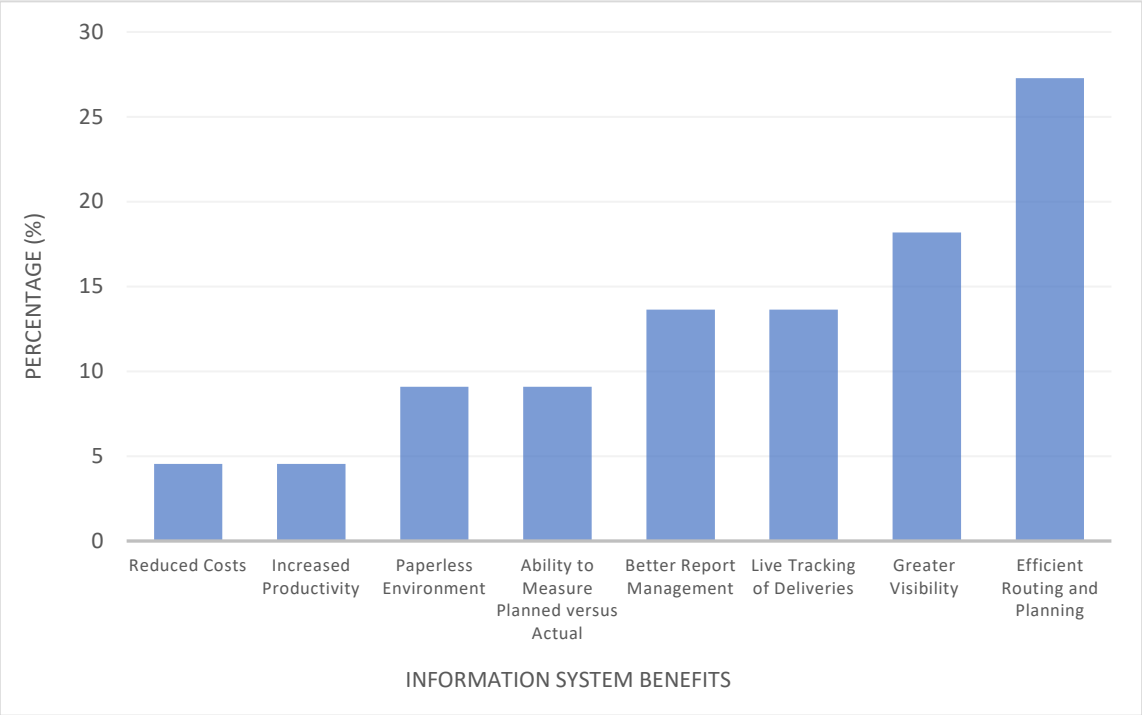


Figure 4- 5 Graph displaying the summary of benefits obtained from the use of IS (%)

The chi-square statistics (X^2) was calculated for the above question. The X^2 of 7.09 indicates a p-value of 0.419 which is greater than the accepted significance level of 0.05. The degree of freedom (Df) calculated to 7. Therefore, the results indicate the variables are not statistically significant at a 95% confidence level.

4.1.5. Question 5: Were there any disadvantages experienced after the system implementation? If yes, briefly explain these disadvantages.

Question 5 involved two questions were the first part was a close-ended question and the second part was an open-ended question where the respondent was required to name a few disadvantages that were experienced after the system implementation. The results of this question are shown in Table 4-6 and Table 4-7 in Appendix 5. Figure 4-6 displayed below illustrates that 46% of respondents have mentioned that there were a few disadvantages from the system implemented, 31% of respondents mentioned that there was no system in place and lastly, 23% of respondents said that there were no disadvantages from the system implemented.

The first mentioned disadvantage was the system bugs and errors that were not identified during the testing phase. Another respondent mentioned that there was an issue of importing data into the system which seemed to be a constant issue. The same respondent discussed that there were functionality issues in terms of integrating with the current billing system. A major challenge that was identified across the data was change management amongst employees. It was such an issue that one of the companies that took the online survey mentioned employees resigned due to implementing a system rather than the manual process that was followed previously. Another challenge which tied in with change management was the inexperience or lack of skills of certain users.

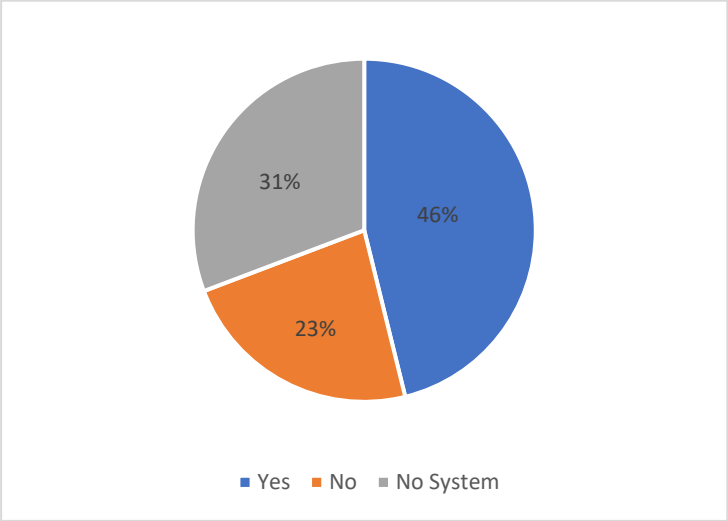


Figure 4- 6 Graph displaying the number of responses to disadvantages after system implementations (%)

The chi-square statistics (X^2) was calculated for the above question. The X^2 of 1.08 indicates a p-value of 0.582 which is greater than the accepted significance level of 0.05. The degree of freedom (Df) calculated to 2. Therefore, the results indicate the variables are not statistically significant at a 95% confidence level.

4.1.6. Question 6: What tools were used prior to the system implementation?

Question 6 was an open-ended question where the respondent was required to describe the tools that were used before the system was implemented, if there were any systems in use. The results of this question are shown in Table 4-8 in Appendix 5.

Based on the findings of the survey responses, 70% of respondents advised that a manual process such as Excel had been used prior to any system being implemented. 15% mentioned that there was already a form of IS that was used and 15% said only a paper-based process was followed. This is displayed in Figure 4-7 below. There was no evidence stating whether any system or paper-based process were used simultaneously.

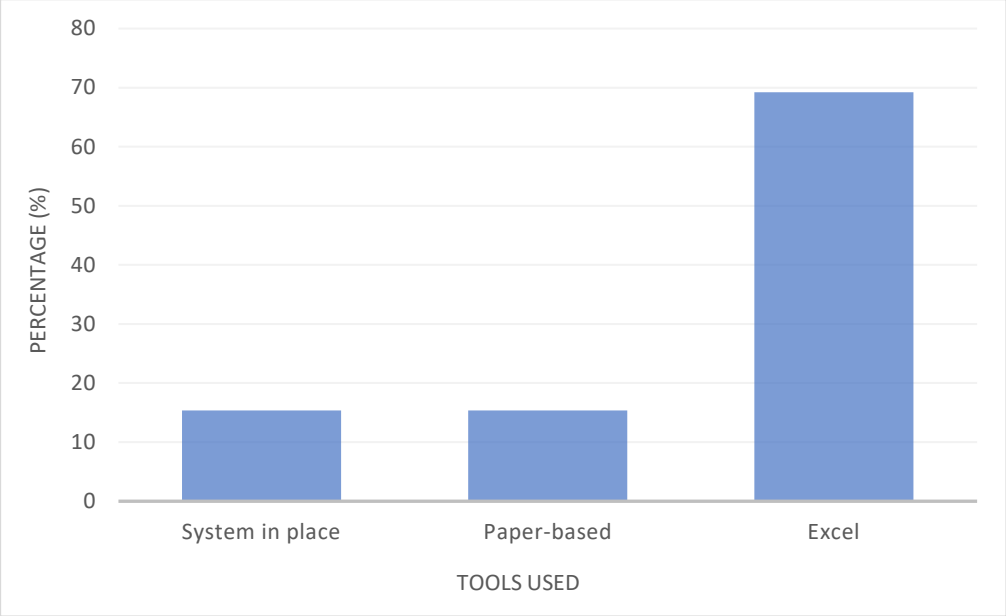


Figure 4- 7 Graph displaying the tools used before system implementations per respondent (%)

The chi-square statistics (X^2) was calculated for the above question. The X^2 of 7.54 indicates a p-value of 0.023 which is below than the accepted significance level of 0.05. The degree of freedom (Df) calculated to 2. Therefore, the results indicate the variables are statistically significant at a 95% confidence level.

4.1.7. Question 7: Did the current system address the current challenges experienced? Please elaborate.

Question 7 involved two questions where the first part was a closed-ended question where the respondent was required to answer if there was an IS that was implemented, where the challenges experienced addressed and the second part was an open-ended question where the respondent was allowed to elaborate on how the system addressed these challenges identified. The results of this question are shown in Table 4-9 in Appendix 5.

From the 69% of respondents having a system implemented, all respondents have answered yes to this question resulting in 100% response rate to challenges being addressed by a system implementation, see Figure 4-8 below.

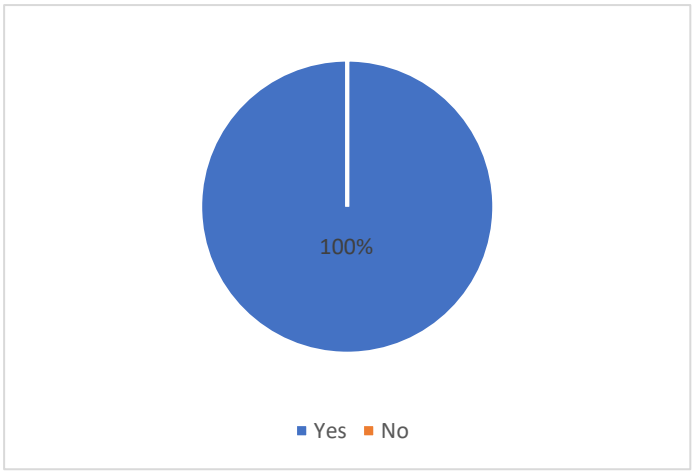


Figure 4- 8 Graph displaying the % of respondents answering if the system addressed challenges

The data derived from the elaboration part of the question identified how previous challenges were improved through the use of IS. Some of these challenged identified included, better routing and planning, improved load consolidation, network design and optimisation, greater visibility created opportunity for enhancements and new processes to shape better performance, and ensured a better utilisation of drivers and vehicles and provides more optimised routes.

The chi-square statistics (X^2) was calculated for the above question. The X^2 of 13 indicates a p-value of 0.0003 which is below than the accepted significance level of 0.05. The degree of freedom (Df) calculated to 1. Therefore, the results indicate the variables are statistically significant at a 95% confidence level.

4.1.8. Question 8: If there is no system in place, has the company considered one? What are some of the reasons why and what tools are currently being used to manage the operation?

Question 8 involved three questions where the first part was a closed-ended question where the respondent was required to answer if the company had considered implementing a system if there was not one in place already and the second and third part involved an open-ended question where reasons were required as to why the company considered it and what tools were currently being used. The results of this question are shown in Table 4-10 in Appendix 5.

From the result of this question, as seen in Figure 4-9 below, 92% of the respondents answered yes to the question of whether a system was considered. Whereas 8% answered no to a system implemented.

Some of the reasons that were highlighted based on the data received included, to ensure the risk of planning orders to the incorrect area is prevented, and to eliminate the need for manual work which can be time-consuming and increases the chances of human error. It also creates greater visibility of deliveries taking place and it allows issues with any of the deliveries to be identified easier.

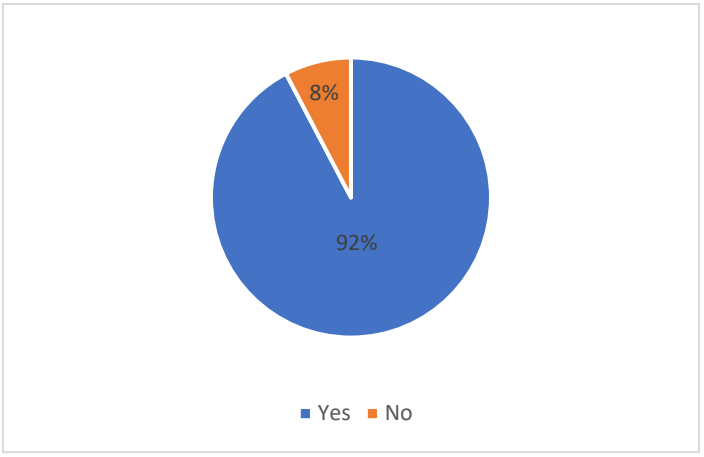


Figure 4- 9 Graph displaying the % of respondents answering if the company considered system implementations

The chi-square statistics (X^2) was calculated for the above question. The X^2 of 9.31 indicates a p-value of 0.002 which is below than the accepted significance level of 0.05. The degree of freedom (Df) calculated to 1. Therefore, the results indicate the variables are statistically significant at a 95% confidence level.

4.1.9. Question 9: Are there any challenges taking place by doing the process manually? If yes, what are some of these challenges?

Question 9 involved two questions where the first part was a closed-ended question requiring the respondent to answer if there were any challenges experienced from a manual-based process and the second part consisted of an open-ended question where the challenges were described. The results of this question are shown in Table 4-11 in Appendix 5.

Based on the survey responses, it was evident that there are challenges experienced when having a manual-based operation. In this case, 69% of the respondents stated there are challenges from following a manual process, see Figure 4-10 below.

Some of the reasoning included the issue of human involvement and hence more errors occurred. It is more time consuming, less efficient and increased cost occurrences due to loss of quick processing of work. Other major issues are the incorrect routing of deliveries which could affect key performance indicators.

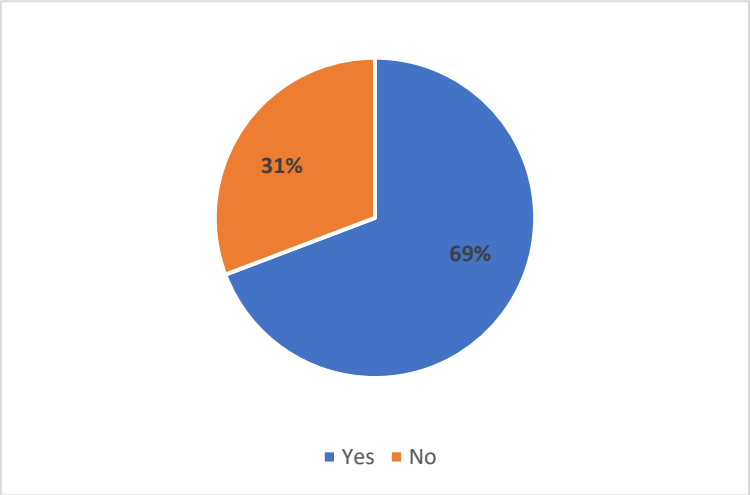


Figure 4- 10 Graph displaying the responses to challenges of a manual process (%)

The chi-square statistics (X^2) was calculated for the above question. The X^2 of 1.92 indicates a p-value of 0.165 which is greater than the accepted significance level of 0.05. The degree of freedom (Df) calculated to 1. Therefore, the results indicate the variables are not statistically significant at a 95% confidence level.

4.1.10. Question 10: Please rate based on the scale whether you think information systems can have a significant impact in reducing current challenges faced with transport optimisation? Please elaborate.

This question was analysed based on the Likert scaling from strongly agree to neither agree nor disagree. It also included an open-ended discussion section where the respondent was requested to elaborate on the agreement level chosen from the Likert scaling. The results of this question are shown in Table 4-12 in Appendix 5.

Based on the results shown in Figure 4-11 below, 62% of respondents stated that they strongly agree to systems having a significant impact on the business. There was a rating of 38% for agree and 0% for the rest of the rating options. With both strongly agree and agree has the feedback, it can be identified that IS are seen has having an effect on the manner in which the transport division of the business is managed.

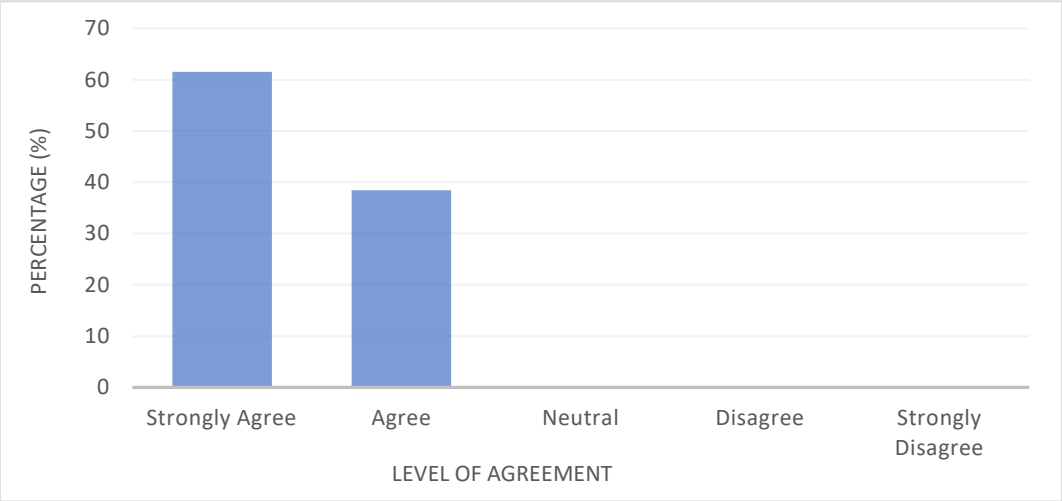


Figure 4- 11 Graph displaying the level of agreement towards IS significance (%)

The chi-square statistics (X^2) was calculated for the above question. The X^2 of 21.23 indicates a p-value of 0.0002 which is below than the accepted significance level of 0.05. The degree of freedom (Df) calculated to 4. Therefore, the results indicate the variables are statistically significant at a 95% confidence level.

4.2. Analysis of the Historical KPI and Transactional Data:

The quantitative research analysis involved historical KPI and transactional data based on an FMCG company. This data was used as part of the quantitative data analysis which assisted in the analysis of the qualitative results. For the purpose of this study, the company that was analysed was kept anonymous. The company analysed has been referred to as Company A.

4.2.1. Company A

The data received for Company A was supplied to the researcher by a consulting company that has also been kept anonymous for the purpose of this study.

The analysis of this study identified various trends based on historical KPI and transactional data on how the IS implemented impacted the operation and whether this impact was substantial or not.

4.2.1.1. Summary of the Data Analysis and Results both Pre-Implementation and Post-Implementation:

The consulting company provided data that consisted of KPI and transactional data which assisted in calculating a summary of the tons delivered, number of shipments, vehicle utilisation and the total cost of transport which were derived based on the company's performance before and after implementation and is shown in Table 4-5 in Appendix 6. The data was collected using Microsoft SQL where the data was stored in tables which made it easy to access historical data. The data was then stored as Microsoft Excel spreadsheets for the data analysis. The purpose of the data collection was to gain further insights into understanding and determining whether IS can indeed assist in improving transport optimisation issues.

There was a difference of R7 million in savings for the total transport cost alone which accumulated for 12 months after go-live. This data was analysed to show the distinct differences in the performance of the operation comparing the results of pre-implementation and post-implementation of the system. This assisted in answering the research question as to whether an IS solution can address transport optimisation issues as well as assist in the performance of the business.

The IS that was implemented was in an attempt to minimise transport cost, distance travelled, time, and vehicle utilisation. The system involved a solver and algorithms to achieve the customer's requirements. The results showed a substantial savings not only in the total transport cost but also the internal transport delivery levels. The number of shipments delivered went from 6724 to 8002 shipments with a difference of 50 549 tons extra being delivered to end customers. But at the same time with the extra volume being delivered, the total transport cost was reduced significantly.

One of the key challenges was to ensure the delivery of urgent orders on-time and in-full as well as ensuring the total number of vehicles reduced to obtain an optimised fleet size and vehicle utilisation levels. Sections 4.2.1.2 to 4.2.1.7 describe the quantitative data in more detail.

4.2.1.2. The Total Number of Shipments per Month:

The number of shipments delivered per month was analysed to understand if the company was able to deliver more orders in a more frequent manner after a TMS solution was deployed. The results shown in Figure 4-12 below, demonstrates that the data for the first six months before implementation which equated to a total of 6724 shipments. This was then compared to six months after implementation and it amounted to a total of 8002 shipments. Hence, there was a difference of 1278 extra shipments that the company was able to execute. December, being a peak month, was also used as part of the data analysis before implementation of the IS. Even though December was used as part of the analysis, the results still showed a significant increase after go-live. The increase amounted to 19% in a period of six months. Table 4-6 in Appendix 6 demonstrates the statistics for six months pre and post go-live.

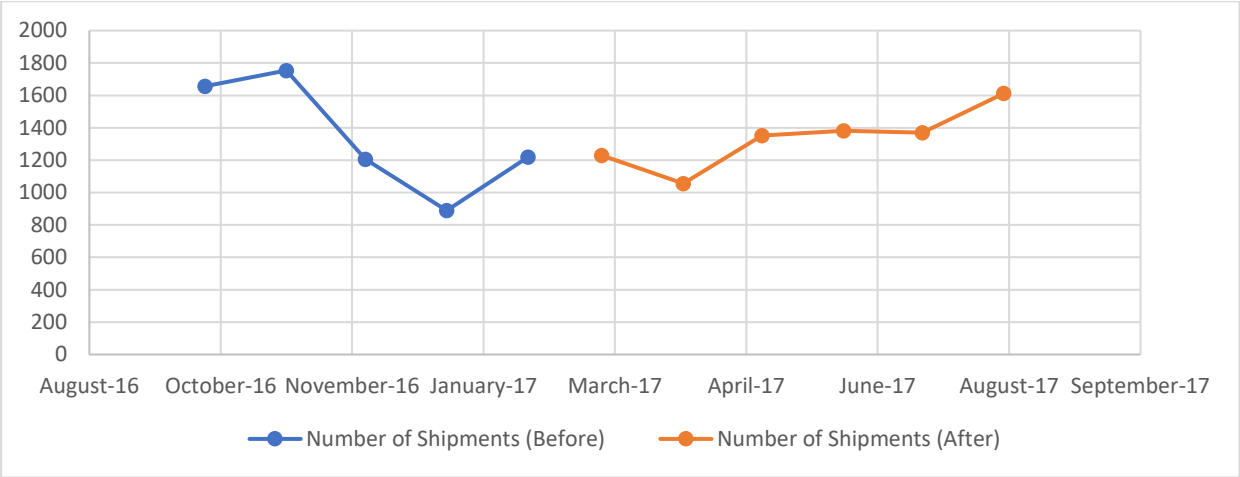


Figure 4- 12 Graph displaying the number of shipments before and after system implementation

4.2.1.3. Driver Adherence to the use of the Scheduled Plan completed by the Transport Management System: The data for this section was based on an average rate after the system was implemented for one month, October 2017, which was considered one of the peak months in the operation. The analysis looked at the number of schedules that were planned per day per region which was then summarised based on the driver adherence to the actual plan. The system worked in a manner that once the deliveries for the day had been scheduled in the system, the finalised plan was imported into a mobile application using a mobile device. The mobile application is integrated with the transport system and displayed the finalised plan with actual stops per delivery for the driver to follow. The driver then signed in and followed the route which was recorded to measure adherence to the application by drivers. The mobile device system is similar to that of a live GPS unit.

Based on the results displayed in Figure 4-13 below, the data showed that the average percentage of drivers that followed the finalised schedule on the device averaged at 77%, leaving a total of 23% of drivers not adhering to the use of the application. The 23% of drivers meant the drivers did not execute the deliveries as per the scheduled plan. Some of the reasons identified for non-adherence were due to driver misunderstanding of the device's functionality, a level of unwillingness to work with an automated solution rather than a paper-based trip sheet as well as overall miscommunication from supervisors.

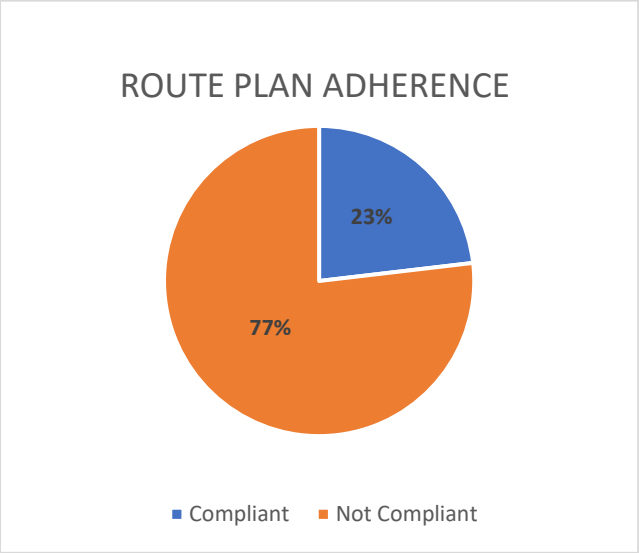


Figure 4- 13 Chart displaying the route plan adherence by drivers

4.2.1.4. The Total Number of Vehicles per Month:

An analysis was conducted to illustrate the number of vehicles per month. Figure 4-14 below demonstrates data three months prior to the go-live and twelve months after the system was implemented. It shows that the company started with a fleet size of 311 vehicles and a month after go-live, in April 2017, the number of vehicles reduced to 307. By the end of 2017, the total number of vehicles dropped significantly to 276 vehicles resulting in a reduction of 11%. A year after go-live, the total number of vehicles for the company was 272 vehicles which equated to a 12.5% reduction. This aided towards a savings in transport cost for the company over the year.

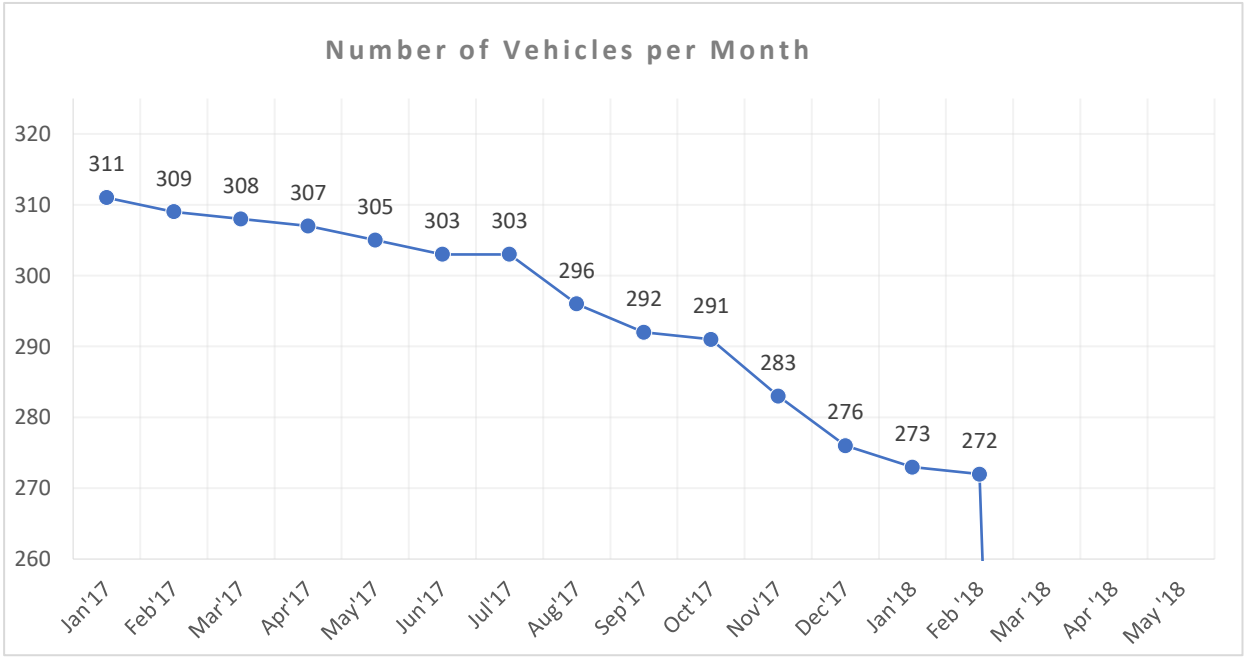


Figure 4- 14 Graph displaying the number of vehicles per month

4.2.1.5. The Utilisation of the Vehicles:

Figure 4-15 below demonstrates five months of data prior to go-live and twelve months thereafter. The average vehicle utilisation across the first five months was 68% which then improved significantly. The month of April and December 2017 ranked the highest with a utilisation of 86%. With December being one of the peak months for the company, the advantages of such an increase in vehicle utilisation was deemed as a significant improvement. The total average across the twelve months amounted to 80%. A difference of 12% increase in vehicle capacity utilisation for the business which the use of the system brought about.

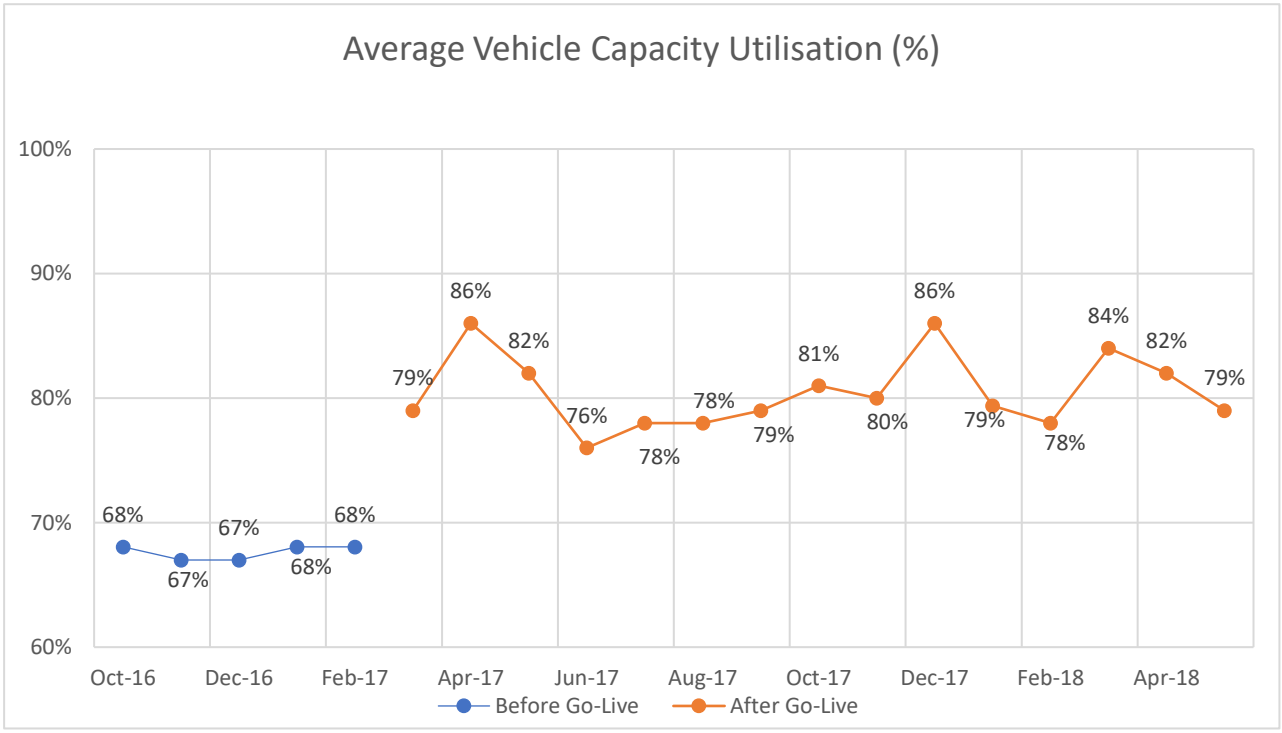


Figure 4- 15 Graph displaying the average vehicle utilisation per month

4.2.1.6. The Breakdown of Cost Savings:

The data included costs in terms of the savings obtained per month as shown in Figure 4-16 below. This was summarised based on the number of vehicles and the costs per vehicle reduced and the total transport cost savings. Figure 4-17 below shows the total number of vehicles per month which is used in the cost statistics and calculations. Table 4-7 in Appendix 6 shows the breakdown of each cost value per month.

The vehicle disposal savings amount was calculated based on the difference from month one and two which was then multiplied by the individual vehicle monthly cost of R30 450. In February 2017, one month prior to go-live, the company managed to reduce the vehicles by two vehicles, equating to an actual savings of R60 900.

The variable costs of the vehicles were also taken into account on a monthly basis of which the savings was calculated based on the reduction of fuel usage and overall running and maintenance costs of the vehicles.

The actual savings involved the sum of the disposal savings amount and the variable cost savings. Lastly, the actual cumulative savings was calculated by the addition of the vehicle variable cost savings and the actual cumulative savings. By the end of the one year after go-live, the total cumulative savings was approximately R7.9 million and a monthly savings of R1.3 million. Comparing the first month's savings of R125 000 in March 2017 as actual savings to R1.3 million in February 2018, the company has saved a massive amount on transport costs.

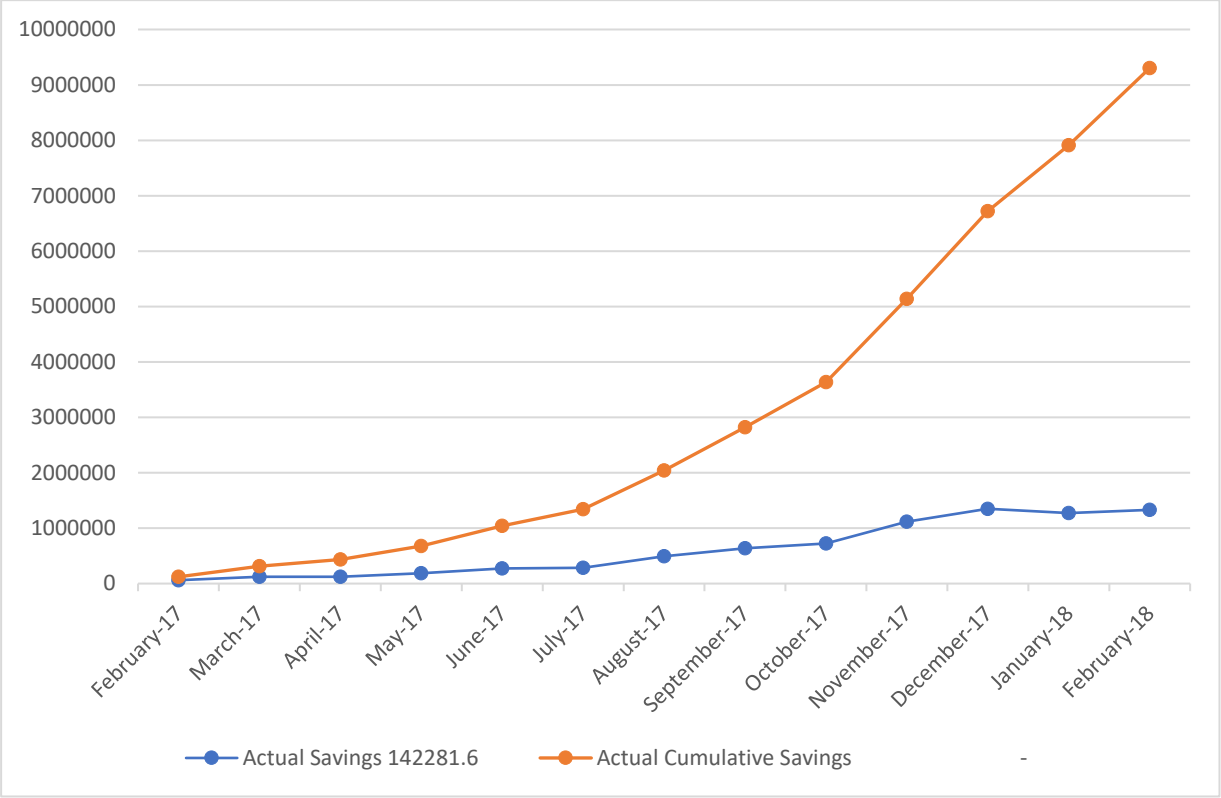


Figure 4- 16 Graph displaying the vehicle savings per month

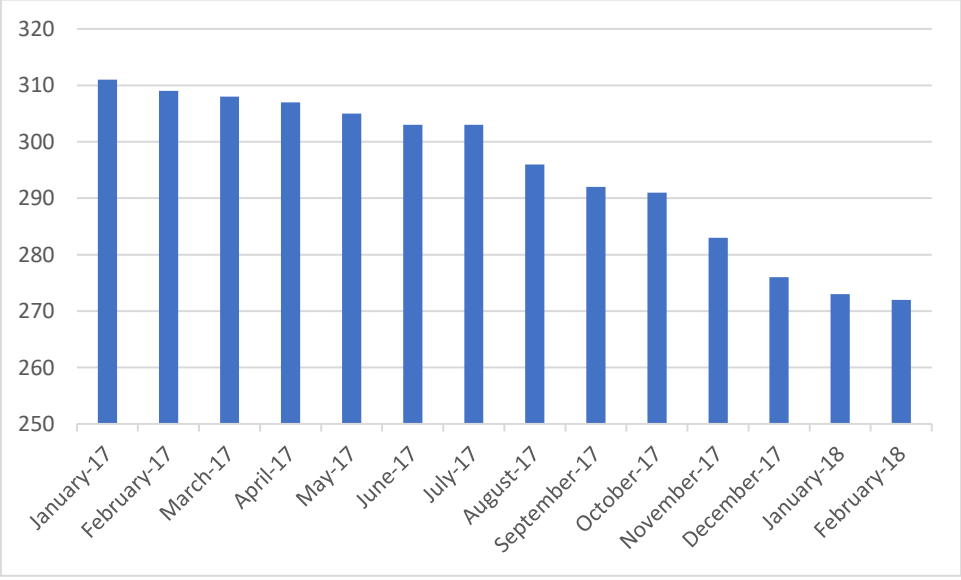


Figure 4- 17 Graph displaying the total number of vehicles per month

4.2.1.7. Total Savings prior to the TMS being implemented:

The findings for this section illustrate that from the period the system was implemented within the operation, there was a large amount of savings that the company have benefited from. Based on Figure 4-18 below, the graph displays that by the end of February 2018, there was a cumulative savings of R7.9 million. At the beginning of the go-live which took place in March 2017, the cumulative savings equated to R185 903. Therefore, in the 12 months of a system being used, the company achieved a significant savings due to the system implemented.

These amounts of savings achieved per month clearly highlights that there were benefits obtained from the implementation and the use of the IS. These will be discussed in detail in the next chapter.

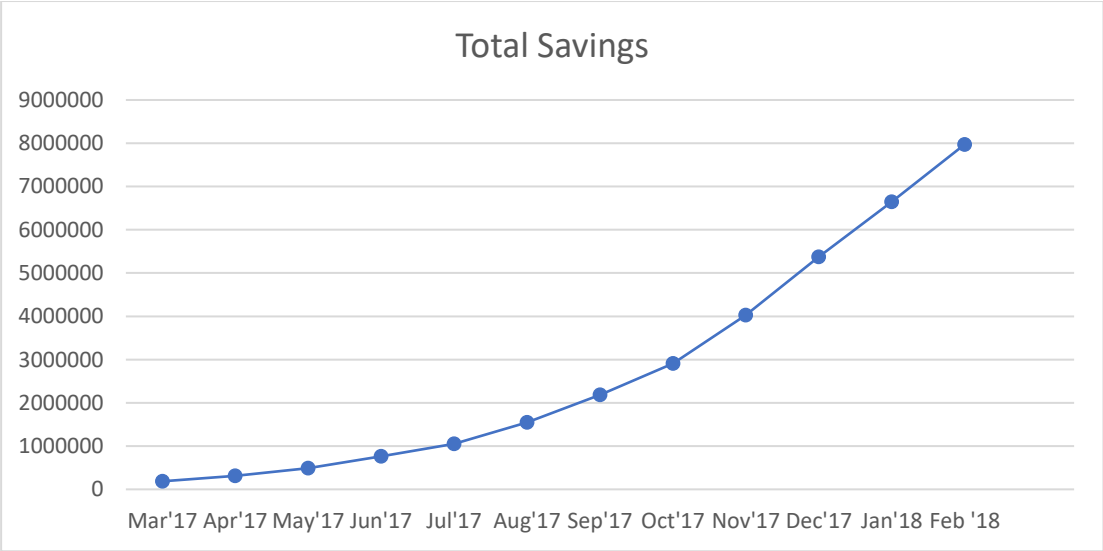


Figure 4- 18 Graph displaying the total savings after implementation

CHAPTER 5

5. DISCUSSION

This chapter focuses on the discussion of the research findings based on Chapter 4. The purpose of this study was to explore the use of IS within supply chain management to address transport optimisation issues in selected companies in the FMCG industry and the impacts thereof. The research also aimed to identify specific optimisation challenges that were being experienced by businesses and whether or not the use of IS can in fact assist in the improvement of these challenges.

Based on the findings and results of Chapter 4, a detailed discussion was outlined to further conclude the results. The discussion is split into different segments which include the following:

- Section 5.1: Current transport Operations
- Section 5.2: Transport Optimisation Challenges
- Section 5.3: The Use of Manual-Based Processes and the Challenges
- Section 5.4: Information Systems Used and the Benefits Obtained to address Transport Optimisation Issues
- Section 5.5: Comparison between Manual-Based and IS-Based Processes
- Section 5.6: The Challenges with IS Implementations
- Section 5.7: Reasons why Companies are not Implementing Systems within the Business
- Section 5.8: Reasons why Companies want to Implement Systems within the Business
- Section 5.9: Summary of the Discussion

As discussed in Chapter 3, concurrent triangulation was used as part of the research method whereby both qualitative and quantitative data were collected and analysed simultaneously, and the results were then combined which will be discussed in this chapter. As a starting point to the research question, based on the findings in Chapter 4, there are issues with transport optimisation within a few organisations in the FMCG industry that need to be addressed. From the feedback received in Section 4.1.10, 62% of the respondents strongly agreed and 38% agreed that transport IS can have a significant impact in addressing these issues and challenges currently experienced.

5.1. Current Transport Operations

5.1.1. Qualitative Results: The Transport Operations identified from the Online Surveys

The results showed that most of the FMCG transport operations involved transport route planning and scheduling for orders on a daily basis. The operations receive orders that must be planned for delivery based on the expected delivery date. The orders are planned either using a system or an Excel file for delivery to end customers or other stores and warehouses by owned or contracted fleet.

31% of the responses received advised that there is already an IS in place which assists with daily planning, delivery and execution of loads as seen in Figure 4-2 in Section 4.1.2 in Chapter 4. Some of the survey responses received in relation to a system-based operation were summarised as follows:

Orders are received and once the warehousing process has been completed, the orders are consolidated based on the plans derived for the day of delivery which was formulated based on the plan from the TMS. This consolidation is based on the different routes and trips which the driver will follow to complete the deliveries per area. Once the vehicle has dispatched from the warehouse, the loads are executed and tracked using a live tracking and monitoring system.

Based on Figure 4-7 in Section 4.1.6 in Chapter 4, one of the results identified in the survey responses in relation to a manual process being followed involved the operation working with Excel plans that get executed daily and then tracked using the current GPS provider. The results from Section 4.1.9 in Chapter 4 identified various challenges relating to a manual-based process and will be further discussed later in this chapter to identify how this process impacts the entire operation as well as service levels.

Based on the results from the survey responses, another transport operation was described has having 16 distribution centres (DC's) across South Africa and using both owned vehicles and contractors to complete deliveries. With this type of operation, it will be essential to have an efficient process in place to be able to control and monitor the entire transport process from the time the orders are planned to the time it gets delivered to the end customer. The need to ensure all 16 DC's have properly planned and distributed deliveries as well as the management of whether owned or contracted vehicles are used across all operations can be difficult to manage and execute properly.

As per the results found from the survey responses, whether a system or a manual paper-based process is used, the operational functionality remains more or less the same in terms of how orders need to be planned for delivery and then monitored and tracked to ensure actual delivery takes place and to achieve some level of KPI ratings. The question comes in on which process followed is the most efficient and effective in terms of transport optimisation and achieving optimal customer service levels at the most cost-effective manner. This chapter will be detailed in terms of the challenges of manual-based processes and benefits of using an IS.

5.1.2. Quantitative Results: The Transport Operation of Company A

The following data describes the operation of the FMCG Company, Company A, and was provided by the consulting company that has also remained anonymous for the study.

Company A involved the planning and delivery of shipments to end customers within the FMCG industry. The planning of the loads was done using an excel-based process which became time consuming and

unproductive. As the number of deliveries and customer demand increased, this process was not the most efficient and the need for a more reliable and optimised solution to assist the business and achieve vehicle optimisation became necessary. Some of the other transport optimisation issues the company faced were the inefficient use of vehicles and vehicle space utilised for deliveries completed. The company contracted the fleet and the transporters hired were paid per kilometre driven. Due to the current planning process, the trips were not being properly planned and managed per transporter. Hence, the number of vehicles used as well as the vehicle capacity utilisation being so low as there was no proper transport system in place to ensure correct routes were followed or orders were being planned and managed correctly to ensure proper utilisation of vehicles as seen in Figure 4-14 and 4-15 in Chapter 4.

In order for Company A to enhance the utilisation of the vehicles to cater for the increase in deliveries and customer demand as well as managing the transporters per delivery, the company outsourced a company to implement an IS needed to assist with the issues experienced. Before implementation of the system, Company A planned the routes of the deliveries on a daily basis for next day deliveries to cater for the high demand of the FMCG industry. These routes were planned based on the destination of the end customer. However, it did not consider the optimisation and deliveries loaded per vehicle. Company A requested the need for a transport management system (TMS) solution in order to allow for better planning and optimisation of routes as well as increasing the utilisation of the existing fleet hired or possibly reduce the number of vehicles needed.

The system was implemented after thorough analysis and go-live took place at the beginning of March 2017. Company A requested the assistance of a supply chain company that developed IS. This outsourced company was tasked to implement an IS solution which will allow for more optimisation and improved service levels to end customers based on the requirements of Company A and was responsible for conducting a detailed analysis of all current processes and designing the optimal solution that will be best suited for Company A.

Appendix 8 and 9 depict the as-is and to-be process respectively. The As-Is process shows how the operational process was before the implementation of the IS and the To-Be process illustrates how the process has changed after the IS was implemented. The process of planning has remained more or less the same with the removal of any paper-based process such as the printing of trip sheets for the driver which was replaced with mobile devices that were used to display all routes and deliveries that had to be executed for the day. Once the delivery was completed and the customer had signed for the delivery on the device, an electronic proof of delivery (ePOD) was generated automatically and pushed to a server storage. This method removed the need for any proof of deliveries to be printed and then filed and stored. The live tracking tool then allowed for visibility of the deliveries as it took place. Besides the use of an IS, there were a couple of inefficiencies and challenges that were improved such as, the reduction of paper printing, automatic report generation based on live data, advancements in technology and interaction with customers and an increase in time due to faster scheduling and the automatic storage of the ePODs.

5.2. Transport Optimisation Challenges

With any transport operation, there comes a number of challenges that can hamper the success of the operation and ultimately affect the level of service provided to customers (Griffis & Goldsby, 2007). A greater number of organisations are aiming to gain a competitive advantage and in the FMCG industry, this is vital due to the high-volumes and customer demand for products as identified earlier in the study in the literature review in Section 2.1 in Chapter 2 (Van Niekerk & Bean, 2019). Based on the findings in Section 4.1.9 in Chapter 4, 31% of responses stated that the use a manual-based process is in place and 69% advised that there were challenges experienced by using a manual-process either currently or prior to the IS being implemented as seen in Figure 10.

The highest ranked challenge related to manual route planning with 22% of the data as seen in Figure 4-3 in Section 4.1.3 in Chapter 4. As discussed in section 5.1 of this chapter, the transport operations involved the need to plan the routes of orders on a daily basis. Without this, the operation will not be able to cater for all deliveries based on the expected delivery dates. Hence, this step within the operation is critical to complete not only correctly but to also to assist with the optimisation of the routes. Based on the data found in Section 4.1.3 in Chapter 4, this challenge related to the company being unable to plan orders optimally which resulted in further issues occurring.

Challenges that were also found in Section 4.1.3, Chapter 4 involves poor order delivery management as well as the consolidation of orders per different area groups. As per the results, one of the challenges found was the issue of combining loads to minimise vehicle utilisation. In terms of the product size and vehicle capacity, the planning and routing process must be able to determine how vehicle utilisation can be reduced by consolidating orders per area and product and vehicle sizes. As a starting point, if the routes are not planned and scheduled efficiently, there will be other challenges that creep into the operation such as the consolidation of orders or exceeding the needed distance and travel times. With an excess of distance and time travelled comes an excess in cost. Within the supply chain portion of the business, the transport cost is ranked one of the highest costs incurred. As per the results, an IS implemented can assist in ensuring these costs are reduced. In Section 4.2.1.7 in Chapter 4, it was identified that Company A achieved a savings of R7.9 million in one year after the system was deployed. This is a considerably large savings to achieve in a year.

An increase in fuel costs was ranked as the second highest transport optimisation issue based on the results coming in at 19% as seen in Figure 4-3 in in Section 4.1.3 in Chapter 4 and as explained by Saeed & Kersten (2019) in Chapter 2, volatile fuel prices will continue to be a major challenge within the transport management. The constant rise in fuel cost has become a major concern for South African companies in terms of deliveries to customers. In the FMCG industry, with the high volumes of orders, this cost can increase the total transport costs significantly. The increase in the total transport cost is mostly affected by the fuel cost as explained by Grabara, Kolcun & Kot (2014) in Chapter 2. Therefore, the business needs to look into ways and solutions to try minimising the waste of travel times and distance to reduce the cost of fuel utilised. As

found in the results in Chapter 4, ways in which to reduce this utilisation involves improved planning of loads as well as vehicle route optimisation and if any return loads, ensure these are planned accordingly to allow vehicles to be booked for both the first and return legs of the trip. This goes back to the use of an optimised transport planning system to assist with an efficient plan.

As discussed earlier, another transport optimisation issue is the consolidation of orders in relation to vehicle capacities that are not managed correctly and as a result a large number of small trips get dispatched. This issue was identified again for manual-based processes during the surveys. Ultimately, with an increase in inefficient small loads being delivered, all costs relating to transport will increase as a result due to no optimisation taking place.

Other challenges that were identified related to incorrect deliveries occurring as well as not being able to meet on-time delivery levels according to the targeted KPIs. Once the achievement of KPIs become affected, it will result in the overall operational success being affected due to poor customer service or cost impacts. In Chapter 2, Bhatti, Awan, & Razaq (2014) explained that KPIs are an important requirement to measure the performance of deliveries to determine how well the business is doing when it comes to certain aspects such as on-time delivery. The vehicle utilisation KPI of Company A increased by 12% after the system was implemented as seen in Figure 4-15 in Section 4.2.1.5 in Chapter 4. With such an improvement, the company is able to reduce a number of vehicles used as well as reduce the total transport costs associated with using less vehicles. Therefore, it is essential the operation ensures an efficient productivity level and optimised transport solutions to assist in achieving the KPI targets set.

5.3. The Use of Manual-Based Processes and Challenges

Due to the emphasis of identifying whether IS can be used to optimise transport, further challenges relating to manual-based processes were discussed in this section.

Manual route planning can have a significantly negative impact on the overall performance of the operation and impact the service levels, therefore also affecting competitiveness within the industry. It can also reduce profits as well as the growth of the organisation (Koster, Carstens & Heyns, 2017), In Section 4.1.3 in Chapter 4, the challenges of poor order delivery management and on-time delivery were also identified, essentially impacting the service levels to customers. Companies are faced with constant increases in customer demands for quicker delivery times especially within the FMCG industry due to the nature of the goods. As per past research conducted by Alicke (2017) in Section 2.6 in Chapter 2, customers are definitely expecting more from FMCG companies for quicker delivery times, faster response times to queries, efficient return processes and improved communication in terms of status of deliveries. However, if there are issues such as poor order delivery management and on-time delivery to customers, the expectations of customers will continue to be a problem for companies to achieve if no action is taken. Therefore, it is of utmost importance that the business

takes all necessary measures in ensuring the best solutions are derived and implemented to cater for the requirements of the business.

In the findings in Section 4.1.3 in Chapter 4, it was identified that with manual planning comes the need to rely solely on human judgement and not having any algorithm in place to identify the most optimal and cost-effective routing of orders. With human judgement, the results can incur errors or risks in not planning the orders correctly per region or routes as well as correct order sequencing. The response received in Section 4.1.3 in Chapter 4 further elaborated that with the involvement of human element, savings are not taken into account when planning as the planner might not always consider whether the plan is the most efficient as possible to reduce fuel and overall transport cost to deliver all the orders. As discussed in Chapter 2 by WordPress (2012), a planning tool will assist the operation in planning all orders according to a logical manner that considers all necessary elements such as time, costs, distance, vehicle capacity, order of delivery and routes to be followed. With only human involvement, not all these elements might be considered resulting in a plan that is not the most optimal.

In the case of transport optimisation issues such as manual route planning, the business must consider market related solutions that can assist the operation most effectively. As explained in Chapter 2 and as shown in the results in Section 4.1.6 in Chapter 4, a large number of companies are still very dependent on a manual-based process which follows using an excel spreadsheet (70%) or a paper-based process (15%) where the planner will plot out the next day's deliveries, not taking into account all the complexities but rather planning according to historical routes or driver preferences which might not be optimal. Endres (2019) explained that such planning can result in expensive inefficiencies and can lead to an increased number of missed or late deliveries which eventually leads to poor performance impacting customer services. With that being said, the risk of manual planning is larger than many organisations expect reducing the potential and opportunity to reduce overall costs. This is the main issue as it involves the ability to reduce the number of vehicles the company has as well as the overall transport and asset costs. If the operation can resolve the challenge of route planning, all else should fall into place in terms of order delivery management, consolidation of orders per area, reduction of vehicles, reduction of transport and fuel costs, and ensuring the level of customer satisfaction is improved by delivering orders on-time and in-full. This was clearly identified based on the results of Company A where although the tons and number of shipments increased, there was still a significant savings achieved which is displayed in Table 4-5 in Appendix 6.

The findings also showed that routes are not being fully optimised and as a result costs are increasing. As described in Section 5.2 of this chapter, this challenge is a major concern and will continue to affect the business if proper solutions are not implemented to achieve the level of optimisation required. Manual-based processes also result in low productivity levels and the inability to keep track of the movement of goods once dispatched from the warehouse. This challenge is important to resolve because as the level of customer demand increases so does the need for better services such as quicker and more frequent communication

methods to customers about the status of deliveries. As technology and IS continues to grow and expand within the supply chain industry, consumer expectations have also grown. This has forced organisations to shift focus onto ensuring any supply chain problem that arises is resolved as soon as possible (Min, Zacharia & Smith, 2019).

Another challenge identified involves the time factor in terms of the manual process taking much longer as there is no algorithm or systematic logic behind human involvement. It also becomes inefficient as there is a lot of manual work that must be done using only an Excel file which can also become slower depending on the size of data utilised for the deliveries to be planned.

Based on the challenges discussed in Section 5.2 and 5.3 of this chapter, the findings identified that there are indeed a number of challenges that companies are facing when it comes to optimising transport processes. With every challenge, comes an additional challenge and if companies do not respond quick enough, these will affect the operation's performance. Therefore, it is essential to identify market trends that can assist with optimising transport and such an example which is the basis of this study is the use of transport IS.

5.4. Information Systems Used and The Benefits Obtained to address Transport Optimisation Issues

Based on the findings from the survey responses, one respondent described the IS in use as a central platform where all order planning takes place. It also demonstrates the performance levels through dashboards, plans and graphs for the operation to view and monitor. Other systems were described as web-based applications that are user-friendly which allows the employees to grasp the system functionality quite easily. It also has the ability that allows both users and consumers to track deliveries in real-time. The world of digitalisation within supply chain and the FMCG industry is growing at a rapid rate and such abilities will take the organisation to the next level over competitors. The types of IS described also related to the use of reports that were available to all users, the ability to give live tracking of deliveries as well as grouping of deliveries in an optimised manner taking into account different elements. As identified during the literature review, there are a number of different IS solutions that companies can use. It all depends on the requirements of the business.

Some of the benefits found included assisting with efficient routing and planning as seen in Figure 4-5 in Section 4.1.4.1 in Chapter 4. The highest ranked transport optimisation challenge found during the result and can have a significant impact when not properly completed. Based on the results from Figure 5 in Section 4.1.4.1 Chapter 4, using an IS can assist the business in reducing costs as well as increasing customer service delivery by ensuring deliveries are planned and dispatched according to the customer's expected delivery date as well as considering the vehicle capacity utilisation and consolidation of orders per the different regions.

Other benefits included greater visibility and efficiency in terms of planning. The users now have the ability to view and track the orders from the time planning has commenced to the time the deliveries take place. It

has also provided better reporting and the ability to measure planned versus actuals which will be good for the measurement of KPIs and other management reports in order to improve service delivery levels to all customers. With the measurement of actuals, there is also the ability to get real-time data of deliveries and tracking of these deliveries. Overall, it increases efficiency and productivity as well as it allows a single view of all the tasks to be completed in terms of the deliveries and routing and scheduling.

The results also identified whether the IS implemented assisted with addressing the transport optimisation challenges experienced. 100% of the respondents that mentioned there is an IS implemented agreed that it did assist in addressing the challenges as seen in Figure 4-8 in in Section 4.1.7 in Chapter 4. The IS described shows that it improved with tracking planned versus actual deliveries. It also assists with greater visibility which creates the opportunity for enhancements and new processes to better shape performance levels. The results also displayed that the IS simplified planning, ensured a better utilisation of drivers and vehicles as well as provided more optimised routes for deliveries. Another respondent described it as addressing route planning, consolidating loads and improving network design and optimisation. Based on Section 2.6 in Chapter 2, the results of the IS addressing challenges can be compared to past research and has a link between the two.

Other findings show that after the implementation of a TMS solution, the total transport cost was reduced through the planning and routing of more optimal deliveries and ensuring the operations adhere to these plans. The TMS solution involves central planning and execution management that ensure compliance with the scheduled plans and the management of any route and delivery exceptions such as late delivery or traffic congestion. These exceptions are managed accordingly, and the customer is informed on time to avoid any bad customer services provided. This adherence not only improves customer satisfaction but also assist with the reduction in costs as drivers are now forced to follow a specified route based on an IS that takes into account various elements and through the use of an algorithm determines the best possible route for all the deliveries.

Imperial Logistics (2013), released a case study on how a big FMCG company within the country has improved significantly after the implementation of a transport IS. The IS was used to enable the company to focus more of the demand for vehicles and ensuring the utilisation levels are reduced by fully optimising all the orders against the vehicles used. Orders were planned against the vehicle availability and no vehicles left without maximum capacity. The majority of the savings were achieved due to the alignment of the demand and supply relating to orders and vehicle availability.

The transport IS that Imperial Logistics has utilised was a cloud-based platform that allowed the FMCG company to easily adapt to the ever-growing changes in the industry as well as cater for the increase in customer demand and at the same time, reducing overall transport costs. It also enhanced the visibility of the transport division bringing benefits of scheduling and tracking of deliveries (Imperial Logistics, 2013).

Another advancement of the system is the integration with an existing enterprise resource planning (ERP) system which reduces the need for any manual working as well as minimising any risk of errors that could occur due to manual work. Having a fully integrated operation in terms of IS allows the company to take the operation to the next level making it more efficient and promoting a seamless end-to-end supply chain flow. The company further elaborated on other benefits such as collaboration between other third-party logistics providers leading to improved optimisation of labour and reduced labour waste as it provides a forward view of the logistics activities and all vehicle requirements. With a view of all necessary activities, the employees involved have the opportunity to improve the manner in which they work due to the increase in resource, ultimately improving productivity levels of workers.

Based on the quantitative results in Section 4.2.1.1 in Chapter 4, Company A saved a total of R7 million in a year of implementing an IS solution. Company A outsourced the management of delivery planning, scheduling and execution to a company that specialises in transport IS solutions. The results demonstrate that the IS company was able to reduce the size of the fleet by 12.5% with a total of 272 vehicles from the original 311 vehicles owned by implementing a solution that fit with the requirements of Company A as seen in Section 4.2.1.4 in Chapter 4. Together with the reduction in vehicles also came an increase in vehicle utilisation. Prior to the implementation, the results show that the average vehicle utilisation was between 67% - 68% as seen in Section 4.2.1.5 in Chapter 4. Whereas after the implementation, the average vehicle utilisation increased to the highest of 86% which was achieved in December, a peak month for the company. The benefits of this reduction in vehicles and an increase in vehicle utilisation included a reduction in fuel and vehicle maintenance costs and an increase in optimisation due to vehicles being able to deliver more.

Other benefits identified as part of the results included a reduction in depot time as vehicles were scheduled according to the plan with a specific loading time. These loading times were calculated based on the volumetric of the products and vehicle capacities and then adhered to with minor deviances. It also included a reduction in driving time as the schedule as well as the mobile-based application which is linked to the planning and scheduling system catered for traffic congestion or diversions. The company employed strict policies to ensure all employees comply with the new process put in place. With the implementation of a TMS solution and a driver hand-held device, an integrated process and system was deployed allowing an improvement in terms of the total collaboration of the operation without any silos being developed among the employees. The mobile device allowed drivers to view the scheduled plan in real-time as well as traffic and any other constraints that may hamper the driver's KPI of delivering orders on-time. It allowed the planner and expeditor to monitor and control driving behaviour as well as any mismatches of deliveries in terms of drivers going off-route or missing any deliveries. This level of service at the operation has improved the overall customer service due to the live tracking and monitoring of all deliveries.

Company A was also able to increase the number of shipments that were being delivered. From 6724 shipments, it was increased to 8002 after implementation as seen in Table 4-6 of Appendix 6. This meant that

Company A was not only able to reduce the fleet but also deliver more orders than before the use of the system with less vehicles and an increase in vehicle utilisation. This alone was an improvement for the company in terms of an increase in optimisation as well as productivity within the operation and overall customer service as the company was delivering 19% more orders with less vehicle resources.

The results of Company A clearly demonstrate the functionality and ability of implementing an IS and what benefits a company can achieve because of this investment as well as addressing the transport optimisation challenges faced such as poor vehicle utilisation. To be part of the world of digitalisation that is rapidly growing within the industry, companies will have to make investments in systems in order to achieve proper optimisation and cost savings. A TMS has become an important investment for any company and in order for the company to remain competitive in the ever-changing business environment, having a system in place is almost inevitable (Oswal, 2018). The initial savings might be slow but in the long term, the investment in a system will be far more beneficial once the savings and overall business improvements start taking shape.

5.5. Comparison between Manual-Based and IS-Based Processes:

Based on section 5.3 and 5.4, a comparison table was developed to identify the differences between the two processes based on the data collection and analysis process.

The table can be found in Appendix 7. There were a number of challenges identified during the research. These include the following:

- On-Time Delivery
- Routing and Scheduling
- Customer Expectations and Service Levels
- Transport Costs
- Productivity
- Sustainability
- Tracking of Deliveries
- Reporting

These challenges were then used to identify the various outcomes if a manual-based and IS-based process were to be used. It was clearly identified that a manual-based process can have a significant effect on the business based on trying to improve these optimisation challenges. Whereas the use of an IS can have a greater benefit to the company in terms of improving the challenges identified.

With on-time delivery, IS can ensure that all expected delivery dates are met through efficient and optimal routing and scheduling (Grabara, Kolcun & Kot, 2014). The most optimised route will be planned considering a number of factors such as traffic and the shortest distance travelled. Live tracking of deliveries also assists in proper communication to customers in cases of delays or to provide updates on the exact location of a

delivery Alicke (2017). Whereas with manually conducting the planning, these factors might not be taken into account resulting in a sub-optimal plan impacting good customer service. The routing and scheduling that takes place using an IS will involve algorithms that ensures the most efficient route is planned for all deliveries (Griffis & Goldsby, 2007). This does not result in human error as can happen with manual planning. A reduction in vehicles can also be the result as seen in Chapter 4 due to vehicles being more utilised and loaded to capacity which leads to a decrease in transport cost. Manual processes do not cater for the vehicle sizes and therefore vehicles can be running almost empty or insufficiently filled to capacity WordPress (2012).

Customer service in the FMCG industry as discussed previously is an important factor and with manual processes, this can easily be impacted. The ability of live tracking provides full visibility of real-time data of deliveries which improves the communication to drivers and customers leading to the competitive advantage a business requires Alicke (2017). Another important aspect is transport costs and having a system that can provide the most optimised and shortest route is the goal when routing and scheduling. It decreases a number of cost elements such as fuel, maintenance and vehicle costs (Kant, 2014). The shorter the distance, the less travel is required which can be easily calculated through the use of algorithms whereas manual-based processes will take much longer to factor in the necessary items required to get an efficient plan.

Productivity in a work environment can result in a seamless and smooth-running operation. The amount of time that it takes to schedule deliveries is the starting point in the process for the warehouse activities such as picking and packing as well as distribution and finally, getting the order to the customer. Comparing the two processes where manual processes can easily take hours to plan and the other a few minutes, provides the basis for the use of an IS (Coyle, et al., 2013). Along with productivity, is the importance of sustainability where printing large amounts of paper such as proof of deliveries and trip sheets are no longer seen as efficient (Chrisos, 2018). Industry trends has introduced mobile devices which allow all transactions to take place electronically and eliminating the need for paper-based environments. This will also allow the company to improve competitiveness and stay in line with the industry trends (James, 2013).

There are significant limitations and disadvantages that are associated with manual-based processes that do not assist with the improvement of transport optimisation challenges whereas the opposite applies for IS-based processes.

5.6. The Challenges with IS Implementations

From the findings, there were a number of challenges that were experienced after the system was implemented. Based on the results from Section 4.1.5 in Chapter 4, 46% showed there were system challenges that were experienced. One of the challenges related to system bugs, errors and data import issues that were not picked up during the testing phase. These affected the operation’s productivity levels up until the errors were resolved.

A major challenge that was identified was the change management process amongst the employees using the new system. Due to no formal change management process being followed for the implementation, it resulted in severe cases of employee resignation as well as improper training and therefore an increase in lack of skills and inexperienced users. Many companies were using a manual-based process for many years and with a change to an automated system that reduces the need of an excel or paper-based process, the employee can become overwhelmed. Based on observations, employees that have to shift from manual work to using a system to plan deliveries do not often want to change as it means a disruption in working patterns and comfort levels and as a result will not use the system correctly leading to inefficiencies and no proper cost savings.

Based on a project observation, a company did a test proof of concept case using the IS and managed to achieve a 20% transport cost savings and therefore, decided to implement the system. After the first three months of using the system, the company did not find any savings at all. When further investigated, it was found that the planner was not using the system correctly. Once the plan was finalised, the planner manually altered it to suit usual behaviour and working patterns, ultimately affecting the optimisation of routes and deliveries (Opsi Systems, 2018). Therefore, it is essential that a company takes into account all employees that will be affected by the new system implementation as it will bring about a huge change in working patterns and productivity levels. According to the Logistics Bureau (2019), within the supply chain industry, change management currently is and will remain a crucial function for any significant initiative, implementation or restructure of processes or business.

Research shows other challenges include insufficient support from top management due to the system costs versus the return on investment. However, according to Gonzales (2014), if the transport manager puts together a clear study in terms of the return on investment and results of a business case demonstrating the exact usage and benefits, managerial support could improve.

5.7. Reasons why Companies are not Implementing Systems within the Business

Studies show that there are a number of reasons why companies are avoiding the use of transport systems as described in Section 2.4 in Chapter 2 (Barloworld Logistics, 2017). Some of these include cost, time, lack of expertise and conflicting priority. Together with the studies and past research from Chapter 2, these will be compared to the results of the quantitative data based on Company A.

5.7.1. Cost:

Many organisations view systems as an expensive investment (Barloworld Logistics, 2017). But according to the results of Company A as shown in Figure 4-18 in Section 4.2.1.7 in Chapter 4, it clearly shows that the company has saved a significantly large amount of money after the system was implement along with a great number of benefits.

5.7.2. Time:

Organisations can also view system implementations as time consuming and ultimately affect productivity. However, according to George (2013), implementations can be completed within one month of complete testing and then deployment. The investment after implementation will result in a greater return on investment in the long term as seen with Company A that saved R7 million in one year of go-live. This savings was displayed in Figure 4-18 in in Section 4.2.1.7 in Chapter 4.

5.7.3. Lack of Expertise:

Koster, Carstens & Heyns (2017) explained that companies having issues with not having the correct expertise to implement the solution is no longer a barrier as there are much more third-party companies that can be outsourced to deploy and manage the implementation along with the company. Company A outsourced the services to a company that specialises in transport IS and ended up with a successful project implementation and solution that saved the company a large amount of revenue. These savings and performance results were shown in Figures 4-15 and 4-17 in Chapter 4 as an example where the number of vehicles and vehicle utilisation improved significantly.

5.8. Reasons why Companies want to Implement Systems within the Business

As described in Section 2.4 of Chapter 2, WordPress (2012) explained there are a number of benefits that can be derived using IS. These include improvement of collaboration and communication, improving customer service levels, improving the business model, and optimising the daily use of the fleet. The findings in Section 4.1.4.1 in Chapter 4 show a number of reasons listed as to why companies want to move towards an automated solution such as transport systems. One of the reasons include having a system in place that uses logic over human judgement which will optimise vehicle utilisation whilst reducing costs. Assisting with meeting KPI targets have also been identified. The results demonstrate that IS can assist with ensuring deliveries take place on-time and in-full.

In Chapter 2, Supply Chain 4.0 was described as the future of supply chains and the potential it has on business processes. The overall competitiveness and performance of a business can significantly improve if companies start thinking about the future and what changes it can implement. A big contributor to this success will indeed be the use of more automated and integrated solutions such as IS. As explained by Alicke (2017) in Chapter 2, the planning of transport will allow for more flexibility in terms of optimising vehicle utilisation by applying a cross-company transport optimisation model where vehicle capacities are shared among different companies or warehouses. This will bring about changes for business in terms of better collaboration to reduce costs and improve customer service levels. It is this type of digitalisation and shift required to take the business to the next level. If companies do not start thinking about the future industry changes and market trends, the likelihood of failure in certain aspects of the supply chain can be high.

5.9. Summary of the Discussion

From the findings of the study shown in Section 4.1.4.1 in Chapter 4, there were a number of reasons as to why an IS solution should be implemented and if it can address the issues and have a significant impact on the operation. These included the following reasons which were all identified in the survey responses and quantitative data. These can be found in Appendix 5 and 6.

As a summary of the results found in Chapter 4, the implementation of an IS can assist with transport optimisation issues by enhancing the performance of the operation and business process by making more complex operations more simpler through the use of an IS eliminating the need for any manual intervention. This is also much more possible as there are more possibilities and opportunities available in the industry as found in Chapter 2. Based on the results, the reduction of fuel and other vehicle costs can be achieved by moving from a manual-based process to a system, also allowing the risk of errors by manual intervention to be reduced significantly, saving time and money. By having a system that can plan routes to customers more optimally, the reduction of vehicles and improving vehicle utilisation can be achieved. As seen from past research identified in Chapter 2, the industry is growing at a tremendous rate and the use of manual processes are ineffective to gain a greater competitive advantage. With the ability to view orders in real-time, customers can be informed of any issues or delays with orders almost immediately resulting in excellent customer service. An overall increase in customer satisfaction can be achieved.

With these reasons identified by the online survey, it is evident that IS within the FMCG supply chain industry can have a significant impact in terms of addressing the current transport optimisation issues as discussed earlier as well as improve the overall business. It will become critical for FMCG organisations to focus on ways of improving and optimising transport issues within the supply chain. As discussed, the industry is growing rapidly and with this growth comes more issues and if steps and strategies are not taken to deal with these issues, the organisation can face severe risks of failure and a negative impact on overall profitability and customer service levels.

Although the study focused on one industry, the findings and results were significant as it demonstrated the importance of utilising more automated processes in operations and moving away from traditional paper-based processes, ultimately, eliminating risks such as human error and unnecessary cost increases.

CHAPTER 6

6. CONCLUSION AND RECOMMENDATIONS

The final chapter is based on concluding and summarising the study that took place to conduct this research and to answer the research question. It summarises the results and discussion to determine future recommendations for FMCG companies facing the transport optimisation issues identified.

6.1. Conclusion

The study was based on three research objectives, namely, identifying the transport optimsation issues within the industry, assessing how IS can be used to address these issues, assessing the differences between a manual-based process and an IS process along with the challenges and benefits and lastly, making recommendations as to how IS can improve service levels. Based on the results and discussion, it can be concluded that there is a large amount of transport optimisation issues that FMCG companies are facing. These challenges can be disruptive towards the productivity, performance and cost of the company if a solution is not identified and put into place. The research question related to how the adoption of IS can impact the road transport management in South African FMCG supply chains. From the findings, the research objectives and question were clearly identified.

The findings determined that many companies have not yet transformed digitally. Supply chain management has grown greatly towards the need for constant change in order to remain competitive and relative to international standards. One of these changes include digitalisation and automation of processes within the operation. In chapter 2, Supply Chain 4.0 was discussed as the future of the supply chain industry and will bring about great potential to companies that adopt this methodology of working. The research that was conducted was closely related to Supply Chain 4.0 in the sense of using automated solutions such as transport management systems to assist with minimising optimisation issues. With that being said, the process of working manually is still largely found within companies. Based on the findings, using manual intervention, a large number of optimsation issues were present that affected costs and service levels. Whereas companies that utilised an IS had much more opportunities and growth in terms of cost savings and improved customer service.

Many of the transport optimisation issues identified during the study related to the past research found for the literature review such as increase in fuel costs, poor vehicle utilisation, errors and risks from manual work as well as the increase in customer demand for quicker delivery times and improved services. Therefore, the findings of the data collection and results by the researcher are similar to that found in the literature review from previous researchers.

The opportunity to improve optimisation within transport and supply chain management has increased to a great extent over the number of years and as a result many more companies are beginning to understand the

importance of having a system in place. IS which was once an expensive solution with many risks have changed and have become more accessible to many more organisations in the industry. This has allowed companies to take full advantage of capabilities such as optimal planning, execution, management as well as measurement of transport operations within the business (George, 2013).

As discussed in the study, customer demand within the FMCG industry has increased substantially and if companies do not consider these demands, service levels and competitive advantage will definitely be affected. Therefore, it will be essential for companies to start looking for solutions and ways to ensure transport costs are minimised without compromising on the level of service delivered to customers as well as improving that service by offering services such same-day deliveries. Yavuz & Deligonul (2017) emphasised the importance of a well-structured logistics strategy and its role in cost reduction, capital reduction and service improvement. If a company's logistics strategy is designed correctly and is continuously improved with market related trends that is suitable for the operation, these three elements can be achieved.

Along with this issue, this study showed that without a long-term solution, the lose the company faces could be significant. Although there are challenges experienced after the implementation of an IS solution as identified in the findings, the benefits derived from utilising an IS far outweighs the challenges that were identified after a system implementation. Therefore, the need for an IS to be implemented is of great importance to address the transport optimsation issues experienced as well as taking the company to the next level of competitiveness in the market. IS implementations can also be seen as a contributing factor to significantly to the return on investment and revenue of the company.

6.2. Limitations and Future Research:

Although, the findings identified IS as a contributor to improve transport optimisation, one of the main challenges the researcher found during the study was the collection of qualitative data through the online surveys. More respondents would have helped to increase the response rate and the significance of the data. However, with the help of the quantitative data, the researcher was more confident in the result set. With this limitation, future research can be conducted where more data can be collected to further emphasis or investigate whether there are more challenges experienced with using IS, such as the cost and time factor. This could potentially be studied through observations and data analysis of an actual project.

Further studies can include other industries to investigate the impacts of IS in different industries and if the effects of an implementation are similar.

6.3. Recommendations

The recommendations for the study will be split into different segments, namely, implementing an automated route planning system, change management procedures, outsourcing to a TMS providers with the correct expertise and achieving key performance measurements.

6.3.1. Implementing an Information System Solution:

When considering transport planning, there are various elements and variables that need to be considered to ensure the most optimal solution is implemented to address the current transport issues. Some of these variables include delivery locations, delivery quantities, delivery operating time windows, vehicle availability and capacity sizes, traffic constraints and product capacities to name a few. The need for an automated IS has increased due to these variables mentioned as well as the rise in fuel costs within the country (Grabara, Kolcun & Kot, 2014). A fully optimised routing and scheduling system can assist the business in ensuring all these variables are taken into account when planning the deliveries. As discussed in the study, the challenges of using a manual-based process outweighs the benefits derived from implementing an IS when addressing transport optimisation issues.

Further to the routing tool comes other IS options such as a real-time track and trace system that will allow the planner or expeditor to monitor and control the deliveries taking place (James, 2013). This type of system will enable the level of customer service the organisation wishes to achieve to become a reality due to the ability to provide real-time information regarding deliveries to customers and ensuring deliveries takes place on-time without issues. Even if there are issues that occur during the delivery which in most cases are likely, the user has the ability to inform the customer about any delays or issues that could happen in advance rather than later. It will allow the business to measure and compare planned versus actual performances which will lead to improved performance levels because the business now has the ability to make the necessary changes to any future plans and KPI service levels (Karl et al, 2018).

Endres (2019) explained that even the most experienced transport planner can have issues with planning deliveries manually and hence a more efficient result and plan will be derived from using a system that can provide the most optimised solution for routing and scheduling. Once this has been achieved, all else can fall into place with managing order deliveries and customer expectations.

Customer expectations for an efficient and timely service throughout the process of order fulfilment have increased substantially due to the increase in customer knowledge regarding the internet and the growing changes involved in modern delivery processes such as e-commerce platforms and same day deliveries (Ray, et al., 2016).

With the use of optimisation systems and tools, business can be expanded to greater levels of automation by integrating the transport management system with execution of deliveries. Kant (2014) explained the role of

IS in further optimising the service levels during execution by ensuring the planning and execution of deliveries work together resulting in greater improvements. Integrating the planning and execution, live tracking and improved visibility can be achieved.

Another recommendation in terms of implementing an IS is to ensure proper research in terms of the correct solution is done. A proof of concept can be conducted to ensure the expected results and savings are achieved before implementing the system throughout the transport operations. It will be essential to ensure the system chosen takes into account all necessary variables of the business such as the weights and size of orders, the number of vehicles available, vehicle capacities, express deliveries, delivery windows and customer or store operating hours. These variables are specific to each business and should be considered when selecting the correct system for the business (Ray, et al., 2016). Once the correct system has been chosen, testing is important to ensure all necessary scenarios are conducted. A detailed training plan and manuals should be documented to ensure all employees affected by the new system will be upskilled on all the functionalities of the system. Standard operating procedure (SOPs) should also be documented and made available to all employees as a reference on how to navigate and use the system.

The ultimate goal of the system implementation will be set up the system that not only considers all the required variables but also generates transport plans that reduces the total distance travelled but still meeting the required customer service levels such as the expected delivery dates and being on-time.

According to McKinsey (2017), transforming to a digital supply chain involves three key enablers, namely, a clear definition of what is required, new capabilities and a supportive environment.

6.3.2. Change Management Procedures

Often IS is viewed as the key to all supply chain problems. However, effective change management processes are forgotten leading to a bigger problem after implementation as end users do not fully accept or embrace the new transformation (Milsom, 2018). With every new solution in the business comes the need for support from top management and business. If an IS solution is implemented, managerial support is a must to ensure the change management process is carried out and adhered to correctly to all levels of the business that will be affected by the new solution.

Part of the results and discussion was the challenge of user acceptance and change management which could largely affect the overall performance of both the user and business. If this process is not taken into account before implementation as well as post-implementation, this could result in low employee moral which will then be seen in the results delivered to customers. Hence, the importance of this process. Based on observations, this step is often forgotten, and employees are forced to move from paper-based process which have been worked on for many years to a completely shift in working where employees often are not skilled enough or reluctant to change. Here comes the need for managerial support and proper procedures to be

followed to ensure a smooth change management process is followed. Sufficient training needs to be complied and conducted in advance of the go-live to ensure all users involved will be trained to have the necessary knowledge and skills required to use the IS too be implemented. For any change to work, collaboration between all levels of the business that will be affected by the change will need to be considered. Process changes, technological capabilities and readiness among employees, training, documentation and organisational structure alignment changes should all be carefully considered to ensure a successful project implementation.

A big part of change management is the fear of job loss when the introduction of any new processes occurs. This can also lead to employee unwillingness to comply with the use of the new IS resulting in a potential failed implementation. Therefore, it is key that management consider ways to ensure job loss is handled in the correct manner and any new opportunities that result from future business expansion is communicated from the onset (Stouten, et al., 2018). Part of these ways is to ensure communication to all involved employees are clear and well-provided throughout the journey of the change. If there are ways of expanding the business which will provide opportunities for employees in cases of job losses, this should be made clear. With the reduction of vehicles and savings in costs, the likelihood of business expansion can be high. Therefore, the business can use this as a way to ensure job security to employees. Carefully handling the change management process will ensure employees have job security and in return will be more productive and susceptible towards the IS.

6.3.3. Outsourcing a TMS Provider with the correct expertise

FMCG supply chains can integrate with a TMS provider in order to gain the most beneficial services through the expertise and skills offered (Mangan, et al., 2011). Outsourcing the solution of an IS implementation to a TMS provider can assist the business in reducing transport costs, reduce the in-transit times and create value-added services such as quicker delivery times. All of which can lead to an improved competitive advantage within the industry.

The use of a provider will allow the company to have a fully integrated end-to-end system process. This will involve the entire order fulfilment process from the point of sale, to the time the order is picked and packed using a warehouse management system (WMS) to the use of a TMS that can assist with routing and scheduling of deliveries, to a mobile device that drivers can utilise to track the route and view all the deliveries to be completed, an execution system that provides real-time data of all deliveries that can be managed and lastly, a portal for POD uploads (Mangan, et al., 2011). This process will make the operation a paper-less and more sustainable environment promoting optimisation and efficiency.

6.3.4. Using IS to meet Key Performance Indicators

One of the challenges identified related to late deliveries and as a result poor customer service. IS has provided significant changes in the way KPIs can be measured. The use of IS to monitor and control KPIs have

improved significantly over the number of years (Djordjevic & Krmac, 2016). Performance measurements are continually updating to allow companies to customise dashboards and reports much easier whereas previously generating dashboards was something manual and involved a lot of time and effort to maintain. The way KPIs can be managed as become a process to provide real-time exception handling and continuous improvement instead of only weekly or monthly exception handling (Alicke, 2017). IS can be a good way for companies to address challenges by taking advantages of new ways for the management of performance levels. Alicke (2017) further explained that by using newly available performance management systems that comprise of techniques such as data mining and machine learning, the system will be able to identify the root causes of issues by conducting a comparison of pre-defined indicators or by doing a big data analysis.

By actively monitoring and finding root causes for decreases in KPI targets, the company will be able to increase the overall performance of the business and improve cost savings.

REFERENCES

Adom, D., Hussein, E. & Joe, A., 2018, 'Theoretical and conceptual framework: mandatory ingredients of a quality research', International Journal of Scientific Research, Vol.7, No.1, pp.438-441.

Agigi, A., Niemann, W., & Kotze, T., 2016, 'Supply chain design approaches for supply chain resilience: A qualitative study of South African fast-moving consumer goods grocery manufacturers', Journal of Transport and Supply Chain Management, Vol.10, No.1.

Alicke, K, (2017). Supply Chain 4.0 in Consumer Goods. [Online]. Available on: https://www.mckinsey.com/industries/consumer-packaged-goods/our-insights/supply-chain-4-0-in-consumer-goods [Accessed on: 19 March 2019]

Ali, Z., & Bhaskar, S.B., 2016, 'Basic Statistical Tools in Research and data analsyis', Indian Journal of Anaesthesia, Vol.60, No.10, pp.662-669.

Angkiriwang, R., Pujawan, I.N. & Santosa, B., 2014, 'Managing uncertainty through supply chain flexibility: reactive vs. proactive approaches', Production & Manufacturing Research, Vol. 2, No. 1, pp. 50-70.

Antonenko, P., 2014, 'The instrumental value of conceptual frameworks in educational technology research', Educational Technology Research and Development, Vol.63, No.1.

Awad, & Nassar, 2010, 'Supply Chain Integration: Definition and Challenges', Proceedings of the International Multi Conference of Engineers and Computer Scientists, Vol.1, No.1, pp.1-4.

Barloworld Logistics, (2017). Exploring latest technologies and the Impact on Supply Chain. [Online]. Available on: https://www.barloworld-logistics.com/supply-chain-foresight/ [Accessed: 24 July 2018]

Barloworld Logistics, (2017). Technology trends and South African supply chains. [Online]. Available on: https://www.barloworld-logistics.com/supply-chain-foresight/ [Accessed: 24 July 2018]

Barreto, L., Amaral, A., & Pereira, T., 2017, 'Industry 4.0 Implications in Logistics: An Overview', Procedia Manufacturing, Vol.13.

Bashir, M. & Tanveer, M.A., 2008, 'Reliability and Validity of Qualitative and Operational Research Paradigm', Pakistan Journal of Statistics and Operation Research, Vol.4, No.1. pp.35-45.

Basson, L.M., Kilbourn, P. & Walters, J., 2019, 'Forecast accuracy in demand planning: A Fast-moving consumer goods case study', Journal of Transport and Supply Chain Management, Vol.13, No.1.

Belfreight, (2016). Addressing the Challenges of Transport Logistics in South Africa. [Online]. Available on:http://belfreight.com/news/addressing-the-challenges-of-transport-logistics-in-south-africa-10052016/ [Accessed: 13 June 2018]

Bhandari, R., 2017, 'Impact of Technology on Logistics and Supply Chain Management', IOSR Journal of Business and management, Vol.2, No.17, pp.19-24.

Bhat, A. (2018). Survey Research: Definition, Examples and Methods. [Online]. Available on: https://www.questionpro.com/article/survey-research.html [Accessed: 24 October 2019]

Bhatia, M, (2018). Your guide to qualitative and quantitative data analysis methods. [Online]. Available on: https://blog.socialcops.com/academy/resources/qualitative-quantitative-data-analysis-methods/ [Accessed: 26 March 2019]

Bhatti, M. & Awan, H., & Razaq, Z, 2014, 'The key performance indicators (KPIs) and their impact on overall organizational performance', Springer, Vol.48, No.6, pp.3127-3143.

Cavalcante, S., 2013, 'Understanding the impact of technology on firms' business models', European Journal of Innovation Management, Vol.16, No.3, pp.285-300.

Camman, C. et al, 2017, 'Supply Chain Management and Business Performance: The VASC Model', ISTE Ltd, London.

Cannella, S. et al, 2018, 'Evolving Trends in Supply Chain Management: Complexity, New Technologies, and Innovatice Methodological Approaches', Hindawi, Vol.2018, pp.1-3.

Caporarello, L. et al, 2016, 'Digitally Supported Innovation: A Multi-Disciplinary View on Enterprise, Public Sector and User Innovation', Springer International Publishing, Switzerland.

Castro, F., Kellison, J., & Kopak, A., 2010, 'A Methodology for conducting integrative mixed methods research and data analyses', Journal of Mixed Methods Research, Vol.4, No.4, pp.342-360.

Chiang, I.A., Jhangiani, R.S., & Price, P.C., 2015, 'Research methods in psychology', Canada.

Chrisos, M, (2018). Future Impact of Technology on Supply Chain Management. [Online]. Available on: https://www.techfunnel.com/information-technology/future-impact-of-technology-on-supply-chain-management/ [Accessed: 11 December 2018]

Christopher, M., 2011, 'Logistics and Supply Chain Management', Pearson Education Limited, Great Britain.

Council of Supply Chain Management Professionals, Fawcett S.E., & Fawcett A.M., 2014, 'The Definitive Guide to Order Fulfillment and Customer Service', Pearson Education, New Jersey.

Coyle, J.J. et al, 2013, 'Supply Chain Management: A Logistics Perspective', Southern-Western Cengage Learning, Mason OH.

Creswell, J, (2012). Mixed Method research Design Approach. [Online]. Available on: https://www.researchgate.net/figure/Mixed-method-research-design-approach-Adopted-from-Creswell-2012_fig1_265164515 [Accessed: 30 September 2019]

Crossman, A, (2018). Understanding Purposive Sampling. [Online]. Available on: https://www.thoughtco.com/purposive-sampling-3026727 [Accessed: 6 August 2018]

Crossman, A. (2018). Understanding Secondary Data and how to use it in research. [Online]. Available on: https://www.thoughtco.com/secondary-analysis-3026573 [Accessed: 17 October 2019]

Daniel, E., 2016, 'The Usefulness of Qualitative and Quantitative Approaches and Methods in Researching Problem-Solving Ability in Science Education Curriculum', Journal of Education and Practice, Vol.7, No.15, pp.91-98.

Deloitte, (2014). Supply Chain Leadership. [Online]. Available on: https://www2.deloitte.com/us/en/pages/operations/articles/supply-chain-leadership.html [Accessed: 25 March 2019]

Dempsey, D, (2017). The Benefits of Supply Chain Management. [Online]. Available on: https://www.liaison.com/blog/2017/02/10/benefits-supply-chain-management/ [Accessed: 6 August 2018]

Djordjevic, B., & Krmac, E, (2016). Key Performance Indicators for Measuring the Impacts of ITS on Transport. [Online]. Available on: https://www.researchgate.net/publication/302909689_key_performance_indicators_for_measuring_the_impacts_of_its_on_transport [Accessed: 12 May 2020]

Domenico, T., 2019, 'Big Data and the Computable Society: Algorithms and People in the Digital World', World Scientific Publishing Europe, London.

Dwivedi, A., 2016, 'Innovative Solutions for Implementing Global Supply Chains in Emerging Market's', Business Science Reference, Hershey PA.

Endres, J, (2019). Manual Route Planning can be a barrier to Growth. [Online]. Available on: https://www.paragonrouting.com/en-us/blog/post/manual-route-planning-can-be-barrier-growth/ [Accessed: 18 March 2019]

ER Services, (2017). Chapter 14 Quantitative Analysis Descriptive statistics. [Online]. Available on: https://courses.lumenlearning.com/suny-hccc-research-methods/chapter/chapter-14-quantitative-analysis-descriptive-statistics/ [Accessed: 25 March 2019]

Etikan, I., 2016, 'Comparison of Convenience Sampling and Purposive Sampling', American Journal of Theoretical and Applied Statistics, Vol.5, No.1, pp.1-4.

Evans, J., & Mathur, A., 2005, 'The Value of Online Surveys', Internet Research, Vol.15, No.2, pp.195-219.

Farrell, S. (2016). 28 Tips for creating great qualitative surveys. [Online]. Available on: https://www.nngroup.com/articles/qualitative-surveys/ [Accessed: 22 October 2019]

Fish, L.A., 2011, Supply Chain Quality Management, IntechOpen, Croatia.

Forbes, (2017). Five Trends Shaping the Future of Customer Experience In 2018. [Online]. Available on: https://www.forbes.com/sites/blakemorgan/2017/12/05/five-trends-shaping-the-future-of-customer-experience-in-2018/#3363b9012d9c [Accessed: 25 March 2019]

Frambach, J.M., et al, 2013, Quality Criteria in Qualitative and Quantitative Research. Academic Medicine. Vol.88, No.4.

Frankie, T.M, Ho, T., & Chrstie, C.A, 2011, 'The Chi-square test: Often used and more often misinterpreted', American Journal of Evaluation, Vol.33, No.3, pp.448-458.

Frost H, (2018).Technology, costs, society affecting fleet companies.[Online]Available on:http://www.engineeringnews.co.za/article/technology-costs-society-affecting-fleet-companies-2018-06-29 [Accessed: 13 June 2018]

Frost, J, (2018). Difference between Descriptive and Inferential Statistics. [Online]. Available on: http://statisticsbyjim.com/basics/descriptive-inferential-statistics/ [Accessed: 7 August 2018]

Fryrear, A. (2015). What is a good survey response rate? [Online]. Available on: https://www.surveygizmo.com/resources/blog/survey-response-rates/ [Accessed: 26 March 2019]

Gill, P., Stewart, K., & Treasure, J., 2008, 'Methods of data collection in qualitative research: interviews and focus groups', British Dental Journal, Vol.204, pp.291–295.

Giusti, R. et al, 2019, 'Synchromodal logistics: An overview of critical success factors, enabling technologies, and open research issues', Science Direct, Vol.129, No.1, pp.92-110.

Glatthorn, AA. and Joyner, RL. (2005). Writing the Winning Thesis or Dissertation. A Step-by-Step Guide [Online]. 2nd ed. California: Corwin Press. Available from: https://research-methodology.net/research-methodology/ [Accessed: 16 October 2019]

Goksoy, A., Vayvay, O., & Karabulut, G., 2012, 'The New Competitive Advantage: Technological Change: An Application of Electronic Data Interchange Implementation in SME in Automotive Industry', International Journal of Business Administration, Vol.3, No.6, pp.25-26.

Gonzales, A, (2014) The biggest barrier to implementing a TMS. [Online]. Available on: https://talkinglogistics.com/2014/01/29/biggest-barrier-implementing-tms-today/ [Accessed on: 19 March 2019]

Grabara, J., Kolcun, M., & Kot, S., 2014, 'The role of information systems in transport logistics', International Journal of Education and Research, Vol.2, No.1, pp.1-8.

Griffis, S., & Goldsby, T., 2007, 'Transportation Management Systems: An Exploration of Progress and Future Prospects', Journal of Transport Management, Vol.18. No.1, pp.18-29.

Gubrium, J.F. et al, 2012, The SAGE Handbook of Interview Research, The Complexity of the Craft, SAGE Publications, London.

Haggarty, L., 2009, 'What is Content Analysis?', Medical Teacher, Vol.18, No.2, pp. 99-101.

Hassler, K., Pearce, K.J., & Serfass, T.L., 2018, 'Comparing the efficacy of electronic-tablet to paper-based surveys for on-site survey administration', International Journal of Social Research Methodology, Vol.21, No.4, pp.487-497.

Henderson, J. (2018). Consumers want their deliveries to be free and fast. [Online]. Available on: https://www.supplychaindigital.com/distribution/consumers-want-their-deliveries-be-free-and-fast [Accessed: 7 August 2019]

Hilton, C., 2015, 'The importance of pretesting questionnaires: a field research example of cognitive pretesting the Exercise referral Quality of Life Scale (ER-QLS)', International Journal of Social Research Methodology, Vol.20, No. 1, pp.21-34.

Hinson, R. et al, 2019, Customer Service Essentials: Lessons for Africa and Beyond, Information Age Publishing Inc, North Carolina.

Imperial Logistics, (2013). Imperial reduces costs and boosts service for Pick 'n Pay. [Online]. https://www.bizcommunity.com/Article/196/389/102798.html [Accessed on: 18 March 2019]

James, R, (2013). Supply Chain Management: A Look back, a look ahead. [Online]. Available on: https://www.supplychainquarterly.com/topics/Strategy/20130621-supply-chain-management-a-look-back-a-look-ahead/ [Accessed: 11 December 2018]

Johnson, M., & Stevens, G., 2016, 'Integrating the Supply Chain... 25 years on', International Journal of Physical Distribution & Logistics Management, Vol.46, No.10.

Jovancic, N. (2019). 5 Data Collection Methods for obtaining quantitative and qualitative data. [Online]. Available from: https://blog.leadquizzes.com/data-collection-methods/ [Accessed: 23 October 2019]

Kaiser, K., 2009, 'Protecting respondents' confidentiality in qualitative research', Qualitative Health Research, Vol.19, No.11, pp.1632-1641.

Kakhki, M.D., & Vidyaranya B.G., 2019, 'Information systems for supply chain management: a systematic literature analysis', International Journal of Production Research, Vol.57, No.15-16, pp.5318-5339.

Kant, G, (2014). Advanced Planning & Optimization in Transportation. [Online]. Available on: https://www.supplychain247.com/article/advanced_planning_optimization_in_transportation [Accessed: 22 July 2018]

Karl, A. et al, 2018, 'Supply chain resilience and key performance indicators: a systematic literature review', Production, Vol.28, pp.1-16.

Kelley, K. et al, 2003, 'Good practice in the conduct and reporting of survey research', International Journal for Quality in Health Care, Vol.15, No.3, pp.261–266

Klazema, A. (2014). Types of Quantitative Research for Students and Researchers. [Online]. Available on: https://blog.udemy.com/types-of-quantitative-research/ [Accessed: 26 September 2019]

Kositzky, M. (2012). Automated Routing: The Path to Optimisation. [Online]. Available on: https://www.inboundlogistics.com/cms/article/automated-routing-the-path-to-optimization/ [Accessed: 12 May 2020]

KPMG, (2016). Fast-Consumer Goods Sector Report. [Online]. Available on: https://assets.kpmg/content/dam/kpmg/br/pdf/2016/09/fast-moving-consumer-goods.pdf [Accessed: 26 March 2019]

KPMG, (2018). The future of Supply Chain data. [Online]. Available on: https://assets.kpmg/content/dam/kpmg/au/pdf/2018/future-supply-chain-data-consumer-goods-retail.pdf [Accessed: 19 March 2019]

Koster, E., Carstens, S.C., & Heyns, G.J., 2017, 'The impact of implementing a transport management system on a fertiliser supply chain: a case study', Journal of Contemporary Management, Vol.14, No.1, pp.509-530.

Kumar, D., & Bala, M., 2011, 'Supply Chain Performance Attributes for The Fast-Moving Consumer Goods Industry', Journal of Transport and Supply Chain Management, Vol.5, No.1.19, pp.23-35.

Leedy, P.D., & Ormrod, J.E., 2016, Practical Research: Planning and Design, 11th ed, Pearson: United Kigndom.

Li, X., 2014, 'Operations Management of Logistics and Supply Chain: Issues and Directions', Vol.2014, pp.1-7.

Logistics Bureau, (2018). KPI Key Performance Indicators in Supply Chain & Logistics. [Online]Available on: https://www.logisticsbureau.com/kpi-key-performance-indicator/ [Accessed: 11 March 2019]

Logistics Bureau, (2019). 7 reasons why the supply chain matters to business success. [Online]Available on: https://www.logisticsbureau.com/7-reasons-why-the-supply-chain-matters-to-business-success/ [Accessed: 25 March 2019]

Logistics Management, (2017). Top 8 Logistics Challenges Facing the Industry.[Online]Available on:https://www.logisticsmgmt.com/article/top_8_logistics_challenges_facing_the_industry[Accessed: 13 June 2018]

Mahmood, K, (2017). Overview of Mixed Methods. [Online]. Available on: https://cirt.gcu.edu/research/developmentresources/research_ready/mixed_methods/overview [Accessed: 6 August 2018]

Malhotra, N.K., & Birks, D.F., 2006, 'Marketing Research an Applied Approach', 2nd ed, London.

Mangan, J. et al., 2011, 'Global Logistics and Supply Chain Management', 2nd ed, New Jersey.

Mashiloane, M., Mafini, C., & Pooe, R., 2018, 'Supply chain dynamism, information sharing, inter-organisational relationships and supply chain performance in the manufacturing sector', Acta Commercii, Vol.18, No.1, pp.3.

Mason, R., & Lalwani, C., 2007, Transport Integration tools for supply chain management, International Journal of Logistics Research and applications, Vol.9, pp.57.

Mathu, K., 2019, 'The information technology role in supplier-customer information-sharing in the supply chain management of South African small and medium-sized enterprises', South African Journal of Economic and Management Sciences, Vol.22, No.1, pp.1-8.

Mathu, K., & Phetla, S., 2018, 'Supply chain collaboration and integration enhance the response of fast-moving consumer goods manufacturers and retailers to customer's requirements', South African Journal of Business Management, Vol.49, No.1, pp.1-8.

McFarlane, D.A., 2013, 'The Strategic Importance of Customer Value', Atlantic Marketing Journal, Vol.2, No.5, pp. 63-64.

Meyer, A., 2019, 'An exploration of supply chain risk management in the South African third-party logistics industry', Independent Research Journal in the Management Sciences, Vol.19, No.1, pp.2.

Middleton, F, (2019). Reliability and Validity: what's the differences? [Online]. Available on: https://www.scribbr.com/methodology/reliability-vs-validity/ [Accessed: 13 January 2020]

Middleton, F, (2019). Types of Reliability and how to measure them. [Online]. Available on: https://www.scribbr.com/methodology/types-of-reliability/ [Accessed: 13 January 2020]

Milsom, G, (2018). Successful TMS Implementations. [Online]. Available on: https://talkinglogistics.com/2018/10/29/successful-tms-implementations/ [Accessed: 12 May 2020]

Min, S., Zacharia, Z.G., & Smith, C.D., 2019, 'Defining Supply Chain Management: In the Past, Present and Future, Journal of Business Logistics', Vol.40, No.1, pp.44-55.

Morgan, B., 2019, The Customer of the Future: 10 Guiding Principles for Winning Tomorrow's Business, HarperCollins Leadership, New York.

Narayanan, S., Marucheck, A., & Handfield, R., 2009, 'Electronic Data Interchange: Research Review and Future Directions', Decision Sciences. Vol.40, No.1, pp.121-163.

Nguegan, C., & Mafini, C., 2017, 'Supply chain management problems in the food processing industry: Implications for business performance', Acta Commercii, Vol.17, No.1, pp.2.

Ogunlela, G.O., 2018, 'Integrated Supply Chain Management in the Fast-Moving Consumer Goods manufacturing Industry: A Review', Journal of Economics and Behavioural Studies, Vol.10, No.4, pp.213-220.

O'Marah, K. (2014). The Chief Supply Chain Officer Report. [Online]. Available on: http://scnavigator.avnet.com/wp-content/uploads/2015/04/Chief_Supply_Chain_Officer_Report_2014.pdf [Accessed: 25 March 2019]

Opoku, A., & Ahmed, V., 2013, 'Understanding Sustainability: A View from Intra-organizational Leadership within UK Construction Organizations', International Journal of Architecture, Engineering and Construction, Vol.2, No.1.

Opsi Systems, (2018). Retail & FMCG. [Online]. Available on: https://www.opsisystems.com/industries/view/retail [Accessed: 11 March 2019]

Oswal, N, (2018). 10 Reasons to consider a transport management system (TMS). [Online]. Available on: https://supplychainbeyond.com/10-reasons-to-consider-a-transportation-management-system-tms/ [Accessed on 19 March 2019]

Pierre, E.A., & Jackson, A.Y., 2014, 'Qualitative Data Analysis after Coding', Sage, Vol.20, No.6, pp.715-719.

PLS Logistics. (2015). The 5 Benefits of Transportation Management. [Online]. Available on: https://www.plslogistics.com/blog/the-importance-of-transportation-management/ [Accessed: 8 July 2019]

Price P.C & Jhangiani, R, (2019). Reliability and Validity of Measurement. [Online]. Available on: https://opentextbc.ca/researchmethods/chapter/reliability-and-validity-of-measurement/ [Accessed: 13 January 2020]

Public Health Training Center, (2017). Triangulating Mixed Methods Data. [Online]. Available on: http://training.lowernysphtc.org/introduction-to-mixed-methods-research/analysis-of-mixed-methods-data/triangulating-mixed-methods-data/ [Accessed: 6 August 2018]

Question Pro. (2018). Quantitative Data Collection Methods. [Online]. Available on: https://www.questionpro.com/blog/quantitative-data-collection-methods/ [Accessed: 24 October 2019]

Ramachandran, G., & Neelakrishnan, S., 2017, 'An approach to improving customer on-time delivery against the original promise date', South African Journal of Industrial Engineering, Vol.28, No.4, pp. 109-119.

Ramshaw, A, (2017). The complete guide to acceptable response rates. [Online]. Available on: https://www.genroe.com/blog/acceptable-survey-response-rate-2/11504 [Accessed: 26 March 2019]

Rana, R., & Singhal, R., 2015, 'Chi-square test and its application in hypothesis testing', Journal of the practice of cardiovascular sciences, Vol. 1, No.1, pp. 69-71.

Ray, S.K. et al., 2016, 'Study on Supply Chain Management of Industries in FMCG Sector in Bangladesh', Global Journal of Research in Engineering, Vol.16, No.2, pp.29-33.

Russo, I., & Confente, I., 2017, Customer Loyalty and Supply Chain Management, Routledge, New York.

Sabbghi, A., 2011, 'Global Supply-Chain Strategy and Global Competitiveness', International Business & Economics Research Journal, Vol.3, No.7, pp.63.

Sabri, E., 2015, Optimization of Supply Chain Management in Contemporary Organizations, Business Science Reference, Hershey PA.

Saeed, M.A., & Kersten. W., 2019, 'Drivers of Sustainable Supply Chain Management: Identification and Classification', MDPI, Vol.11, No.4.

Sauro, J, (2015). How to measure the reliability of your methods and metrics. [Online]. Available on: https://measuringu.com/measure-reliability/ [Accessed: 13 January 2020]

Schoonenboom, J and Johnson, RB (2017). How to construct a mixed methods research design. [Online]. Available on: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5602001/ [Accessed: 17 October 2019]

Selected Hub, (2018). 5 KPIs for Supply chain analytics and the tools to find them. [Online]. .https://selecthub.com/supply-chain-management/5-kpis-supply-chain-analytics-tools/ [Accessed: 11 March 2019]

Shamsuzzoha, A., & Helo, P., 2011, 'Real-time Tracking and Tracing Systems: Potentials for the Logistics Network', Proceedings of the 2011 International Conference on Industrial Engineering and Operations Management, Vol.1, pp.242-249.

Shorten A., & Smith J., 'Mixed methods research: expanding the evidence base', Evidence-Based Nursing, Vol.20, No.3, pp.74-75.

Shukairy, A. (2019). 9 Tips to conducting accurate qualitative research. [Online]. Available on: https://www.invespcro.com/blog/9-tips-to-conducting-accurate-qualitative-research/ [Accessed: 24 October 2019]

Silverman, D., 2004, Doing Qualitative Research, 2nd Edition, Sage Publications, Thousand Oaks, CA.

Standard Bank, (2017). Trends affecting transport that every South African logistics business should prepare for. [Online]Available on:https://bizconnect.standardbank.co.za/sector-news/transport/trends-affecting-transport-that-every-south-african-logistics-business-should-prepare-for.aspx [Accessed: 23 July 2018]

Stefanovic, N., 2014, 'Proactive Supply Chain Performance Management with Predictive Analytics', The Scientific World Journal, Vol. 2014, No.1.

Stouten, J., et al., 2018, 'Successful Organizational Change: Integrating the Management Practice and Scholarly Literatures', Academy of Management Annals, Vol.12, No.10.

Surendran, A. (2019). Quantitative Research: Definition, Methods, Types and Examples. [Online]. Available on: https://www.questionpro.com/blog/quantitative-research/ [Accessed: 17 October 2019]

Van Niekerk, H.J., & Bean, W.L., 2019, 'Evaluation of the cost drivers and allocation framework in Outbound Logistics of the Fast-Moving consumer Goods Industry', South African Journal of Industrial Engineering, Vol.30, No.2, pp.115-130.

Varma, T.N., & Khan, D., 2014, 'Information Technology in Supply Chain Management', Journal of Supply Chain Management Systems, Vol.3, No.3.

Wall, P., 2019, Mixed Methods Research. [Online]. Available on: http://resourcecentre.foodrisc.org/mixed-methods-research_185.html [Accessed: 12 May 2020]

Walliman, N., 2011, Research Methods: The Basics, 1st ed. Routledge, USA.

Wilkinson, D. and Birmingham, P. (2003). Using Research Instruments: A Guide for Researchers. [Online]. 1st ed. London: Routledge Falmer. [Accessed: 8 October 2019]. Available from: https://books.google.co.za/books?id=7uWCAgAAQBAJ&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

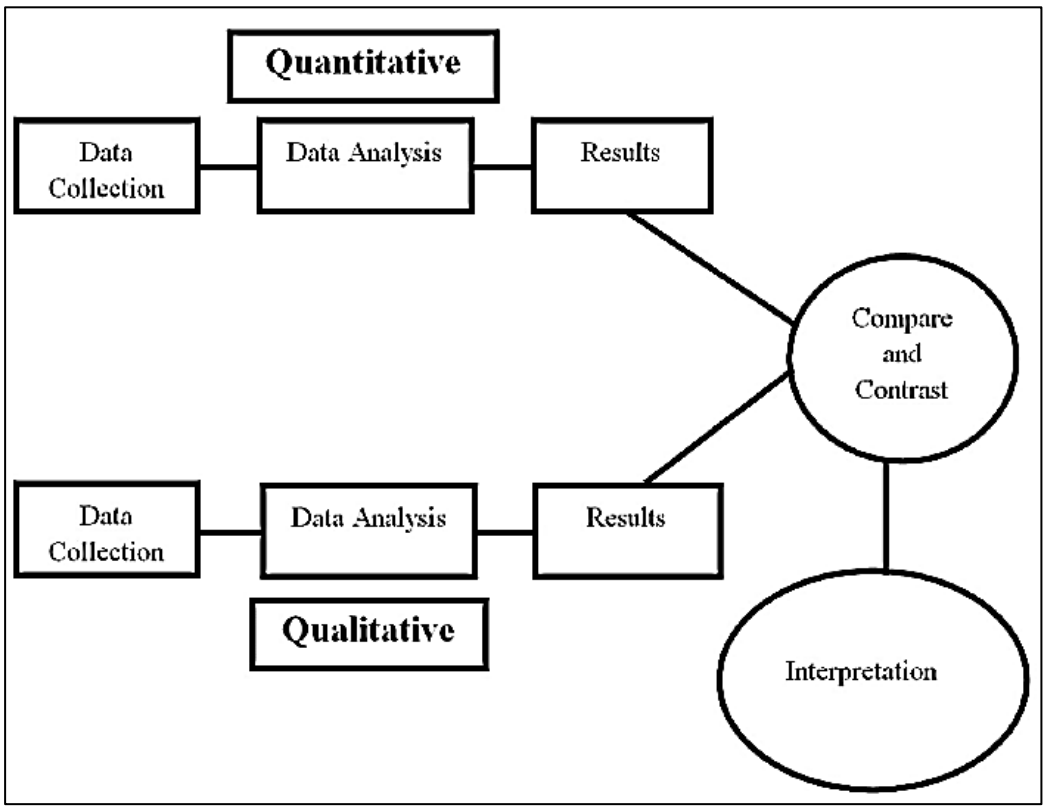
Williams, C., 2007, 'Research Methods', Journal of Business and Economic Research', Vol.5, No.3, pp.65-70.

Wisner, J., Tan, K.C., & Leong, G., 2014, Principles of Supply Chain Management: A Balanced Approach, 4th ed, Cengage Learning, Canada.

Yavuz, M. & Deligonul, B., 2017, 'The Importance of Logistics Information Technologies and Knowledge Management Capabilities on Intermediaries' Performance', IGI Global, United States of America.

APPENDICES

Appendix 1: Mixed Methods Design Approach



Reference: Opoku & Ahmed, 2013

Appendix 2: Cover Letter for the Qualitative Research Method

Dear Participant,

I am a part-time MSc student in the School of Mechanical, Industrial and Aeronautical Engineering at the University of the Witwatersrand, with student number 1768165.

As part of my studies, I am conducting research on 'The use of Information Systems within Supply Chain Management to address Transport Optimisation Issues',

I would like to ask you to kindly assist in this research by completing a questionnaire.

The questionnaire aims to gain some insight into the transport optimisation issues experienced within your company as well as how information systems has assisted in addresses these optimisation issues or if no system has been implemented, what are some of the challenges experienced and what is the current process in helping reduce these challenges.

The questionnaire will take no longer than 10 minutes of your time.

Although your response is of the utmost importance to my research, your participation in this survey is entirely voluntary.

Information provided by you remains confidential and will be reported in summary format only.
Please note that by submitting the completed questionnaire your agreement to participation in the research is assumed.

Kindly complete questionnaire online https://www.surveymonkey.com/r/2MMWG8D before **14 January 2019.**
Should you have any queries or comments regarding this survey, you are welcome to contact me by e-mail: naicker.nerissa@gmail.com

Kind regards,
Nerissa Naicker

Appendix 3: Online Questionnaire

* 1. Participant Information

Industry

Current Job Designation

Province

* 2. Describe how the current transport operation works in your organisation.

* 3. What are the current challenges experienced with the optimisation of transportation and what are some of the measures in place to resolve these challenges?

* 4. Information Systems Utilised

Are there any information systems in place within the transport division?

How would you describe the type and purpose of the system in place?

What are the benefits that the information system has provided?

* 5. Were there any disadvantages experienced after the system implementation?

- ◯ Yes
- ◯ No

If yes, briefly explain these disadvantages.

* 6. What tools were used prior to the system implementation (i.e. excel, paper-based processes, etc.)?

* 7. Did the system address the current challenges experienced?

- ◯ Yes
- ◯ No

Please elaborate.

* 8. If there is no system in place, has the company considered one?

- ◯ Yes
- ◯ No

What are some of the reasons why and what tools are currently being used to manage the operation?

* 9. Are there any challenges taking place by doing the process manually?

- ◯ Yes
- ◯ No

If yes, what are some these challenges?

* 10. Do you think information systems can have a significant impact in reducing current challenges faced with transport optimisation?

- ☐ Strongly agree
- ☐ Agree
- ☐ Neither agree nor disagree
- ☐ Disagree
- ☐ Strongly disagree

Please provide a reason for your answer.

Reference: Developed by the author

Appendix 4: Consent Letter for the Quantitative Research Method

Letter of Consent

I, _____, agree to participate in the MSc research entitled, 'The use of Information Systems within Supply Chain Management to address Transport Optimisation Issues', to be undertaken by Nerissa Naicker under the supervision of Ms Bernadette Sunjka.

I acknowledge that the research has been explained to me and I understand what it entails, as follows:

1. I agree to allow access to my company's data for the purpose of this research.
2. The data will be used in the research anonymously.
3. I have the right to withdraw my assistance from this project at any time without penalty, even after signing the letter of consent.
4. I may request a report summary, which will come as a result of this study.
5. I am entirely free to discuss issues and will not be in any way coerced into providing information that is confidential or of a sensitive nature.
6. Pseudonyms will be used to conceal my identity, and that of my company, my employees, my suppliers and my customers. The information disclosed in the data will be confidential.
7. All data will be securely stored during the research and after the research has been completed.
8. This project was approved by the Faculty of Engineering and the Built Environment of the University of the Witwatersrand and the School of Mechanical, Industrial and Aeronautical Research Ethics Committee (non-medical) of the University.

Signed: _____

Date: _____

Questions concerning the study can be directed to:

Nerissa Naicker
Tel: 083 607 5947
Email: naicker.nerissa@gmail.com

Supervisor: Bernadette Sunjka
Email: Bernadette.sunjka@wits.ac.za

Reference: Developed by the author

Appendix 5: Qualitative Results Tables

Table 4. 1 Table showing the number of respondents per job designation

Job Designation	*Number of Respondents*
Implementation	3
Operations	3
Analysis	4
Engineering	2
Solutions Development	1
Total	13

Table 4. 2 Table showing the split between operational processes

Category	*Frequency*	*Relative Frequency*	*% Split*
Manual-Based Process	1	0.08	8
System-Based Process	4	0.31	31
Undefinable	8	0.62	62
Total	13	1	100

Table 4. 3 Table showing the transport optimisation challenges

Transport Optimisation Challenges	*Frequency*	*Relative Frequency*	*%*
Manual route planning	7	0.23	23
Increase in fuel cost	6	0.20	20
Poor order delivery management	6	0.20	20
Poor KPI performance	3	0.10	10
Poor On-time delivery management	2	0.07	7
High vehicle utilisation	2	0.07	7
Poor management of contracted transporters	1	0.03	3
Low data integrity	1	0.03	3
No cost reduction considered	1	0.03	3
Inefficient Network Design	1	0.03	3
Poor Order Consolidation per area	2	0.06	6
Total	32	1	100

Table 4. 4 Table showing the responses to challenges of a manual process

Category	*Frequency*	*Relative Frequency*	*%*
Yes	9	0.69	69
No	4	0.31	31
Total	13	1	100

Appendix 6: Quantitative Results Tables

Table 4. 5 The above table shows the statistics for 6 months pre- and post- go live.

	Pre-Implementation	***Post-Implementation***	***Difference***
Tons Delivered	217 252 tons	267 801 tons	50 549 tons
Total Transport Cost Savings	R60,900	R7,973,049	R7 912 149
Number of Shipments Delivered	6 724	8 002	1 278

Table 4. 6 The table shows the number of shipments

Month	***Number of Shipments (Before)***	***Number of Shipments (After)***	***Relative Frequency (Before)***	***Relative Frequency (After)***	***% (Before)***	***% (After)***
October '16	1657		0.25		25	
November '16	1754		0.26		26	
December '16	1205		0.18		18	
January '17	889		0.13		13	
February '17	1219		0.18		18	
March '17		1230		0.15		15
April '17		1056		0.13		13
May '17		1352		0.17		17
June '17		1382		0.17		17
July '17		1370		0.17		17
August '17		1612		0.20		20
Total	**6724**	**8002**	**1**	**1**	**100**	**100**

Table 4. 7 The table displays the vehicle savings per month

Month	*Number of Vehicles*	*Vehicle Disposal Savings Amount*	*Vehicle Variable Cost Savings*	*Actual Savings*	*Actual Cumulative Savings*
Jan'17	311	-	-	142,281.60	-
Feb'17	309	60,900.00	-	60,900.00	60,900.00
Mar'17	308	91,350.00	33,653.30	125,003.30	185,903.30
Apr'17	307	121,800.00	1,300.90	123,100.90	309,004.20
May'17	305	182,700.00	1,147.01	183,847.01	492,851.21
Jun'17	303	243,600.00	29,934.90	273,534.90	766,386.11
Jul'17	303	243,600.00	43,766.73	287,366.73	1,053,752.84
Aug'17	296	456,750.00	35,737.03	492,487.03	1,546,239.87
Sep'17	292	578,550.00	58,022.07	636,572.07	2,182,811.94
Oct'17	291	609,000.00	117,411.22	726,411.22	2,909,223.16
Nov'17	283	852,600.00	261,621.00	1,114,221.00	4,023,444.16
Dec'17	276	1,065,750.00	284,114.84	1,349,864.84	5,373,309.00
Jan'18	273	1,157,100.00	112,808.69	1,269,908.69	6,643,217.69
Feb '18	272	1,187,550.00	142,281.60	1,329,831.60	7,973,049.29

Appendix 6: Chi-Square Statistics

Table 4. 8 Chi-square analysis of the split between operational processes

Category	*Observed*	*Expected*	*O-E*	*(O-E)^2*	*(O-E)^2/E*
Manual-Based Process	1	4.33	-3.33	11.11	2.56
System-Based Process	4	4.33	-0.33	0.11	0.03
Undefinable	8	4.33	3.67	13.44	3.10
X^2					**5.69**

Table 4. 9 Chi-square analysis of the transport optimisation challenges

Category	*Observed*	*Expected*	*O-E*	*(O-E)^2*	*(O-E)^2/E*
Manual route planning	7	2.91	4.09	16.74	5.75
Increase in fuel cost	6	2.91	3.09	9.55	3.28
Poor order delivery management	6	2.91	3.09	9.55	3.28
Poor KPI performance	3	2.91	0.09	0.01	0.00
Poor On-time delivery management	2	2.91	-0.91	0.83	0.28
High vehicle utilisation	2	2.91	-0.91	0.83	0.28
Poor Order Consolidation per area	2	2.91	-0.91	0.83	0.28
Poor management of contracted transporters	1	2.91	-1.91	3.64	1.25
Low data integrity	1	2.91	-1.91	3.64	1.25
No cost reduction considered	1	2.91	-1.91	3.64	1.25
Inefficient Network Design	1	2.91	-1.91	3.64	1.25
X^2					**18.19**

Table 4. 10 Chi-square analysis of the summary of benefits obtained from the use of IS

Category	*Observed*	*Expected*	*O-E*	*(O-E)^2*	*(O-E)^2/E*
Efficient routing and planning	6	2.75	3.25	10.56	3.84
Paperless environment	2	2.75	-0.75	0.56	0.20
Greater visibility	4	2.75	1.25	1.56	0.57
Better report management	3	2.75	0.25	0.06	0.02
ability to measure planned versus actual	2	2.75	-0.75	0.56	0.20
live tracking of deliveries	3	2.75	0.25	0.06	0.02
reduced costs	1	2.75	-1.75	3.06	1.11
increased productivity	1	2.75	-1.75	3.06	1.11
X^2					**7.09**

Table 4. 11 Chi-square analysis of the number of responses to disadvantages after system implementations

Category	*Observed*	*Expected*	*O-E*	*(O-E)^2*	*(O-E)^2/E*
Yes	6	4.33	1.67	2.78	0.64
No	3	4.33	-1.33	1.78	0.41
No System	4	4.33	-0.33	0.11	0.03
X^2					**1.08**

Table 4. 12 Chi-square analysis of the tools used before system implementations per respondent

Category	*Observed*	*Expected*	*O-E*	*(O-E)^2*	*(O-E)^2/E*
Excel	9	4.33	4.67	21.78	5.03
System in place	2	4.33	-2.33	5.44	1.26
Paper-based	2	4.33	-2.33	5.44	1.26
X^2					**7.54**

Table 4. 13 Chi-square analysis of the number of respondents answering if the system addressed challenges

Category	*Observed*	*Expected*	*O-E*	*(O-E)^2*	*(O-E)^2/E*
Yes	13	6.5	6.5	42.25	6.5
No	0	6.5	-6.5	42.25	6.5
X^2					**13**

Table 4. 14 Chi-square analysis of the number of respondents answering if the company considered system implementations

Category	*Observed*	*Expected*	*O-E*	*(O-E)^2*	*(O-E)^2/E*
Yes	12	6.5	5.50	30.25	4.65
No	1	6.5	-5.50	30.25	4.65
X^2					**9.31**

Table 4. 15 Chi-square analysis of the responses to challenges of a manual process

Category	*Observed*	*Expected*	*O-E*	*(O-E)^2*	*(O-E)^2/E*
Yes	9	6.5	2.5	6.25	0.96
No	4	6.5	-2.5	6.25	0.96
X^2					**1.92**

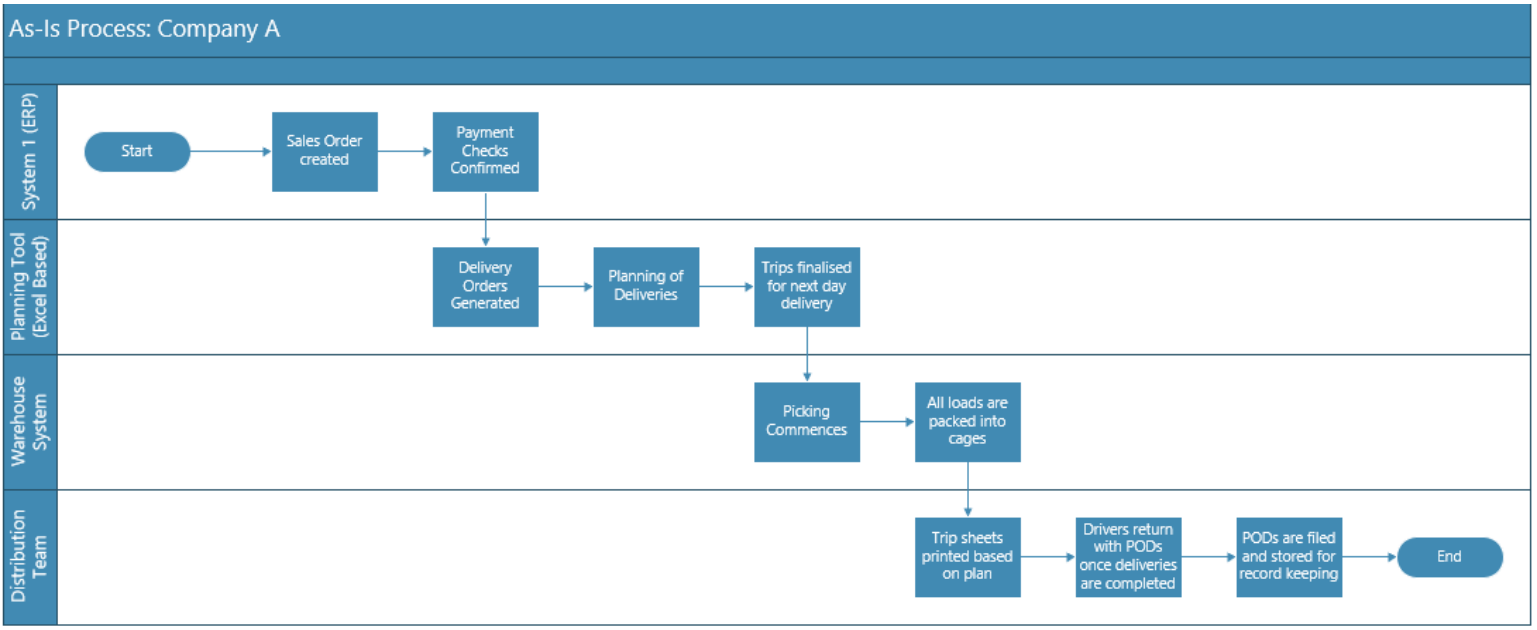
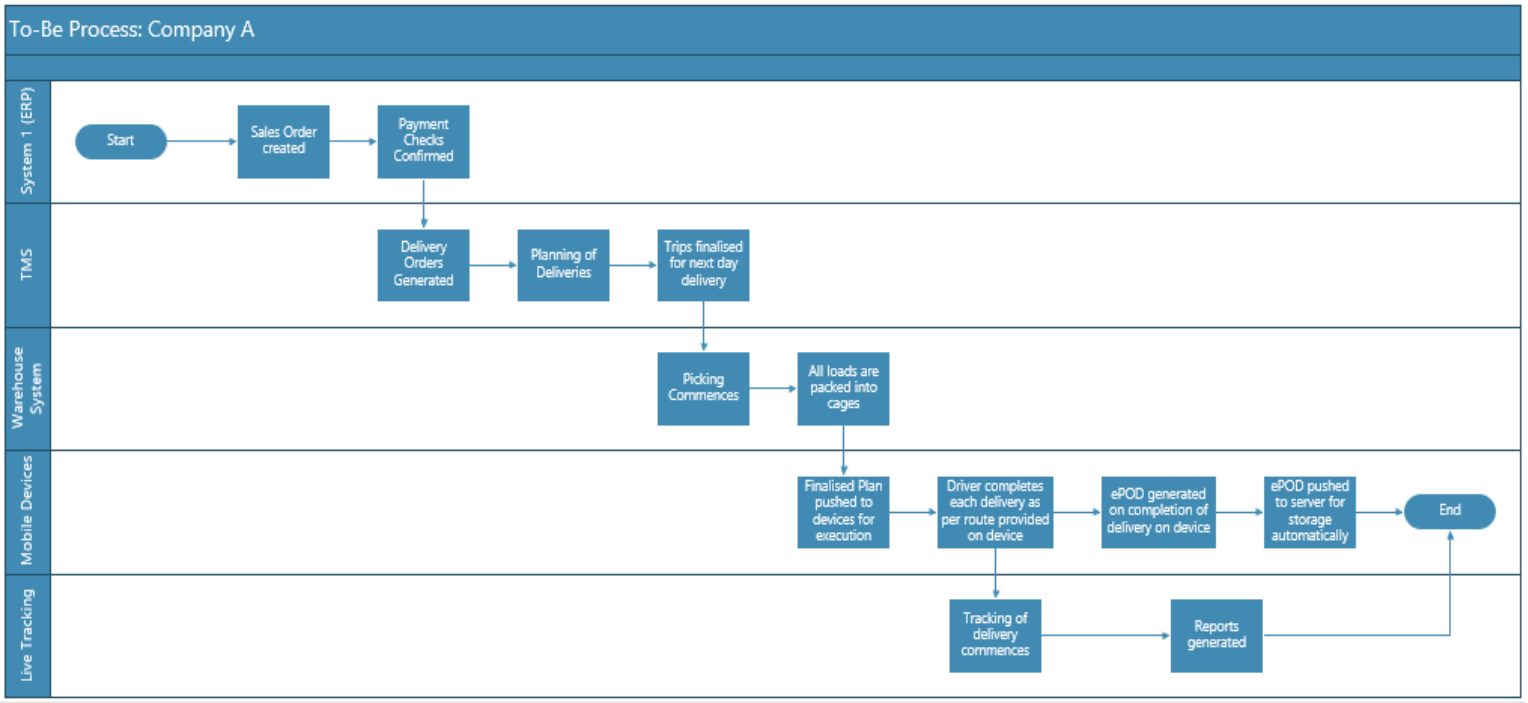
Table 4. 16 Chi-square analysis of the level of agreement towards IS significance

Category	***Observed***	***Expected***	***O-E***	***(O-E)^2***	***(O-E)^2/E***
Agree	5	2.6	2.4	5.76	2.22
Strongly Agree	8	2.6	5.4	29.16	11.22
Disagree	0	2.6	-2.6	6.76	2.60
Strongly Disagree	0	2.6	-2.6	6.76	2.60
Neither Agree nor Disagree	0	2.6	-2.6	6.76	2.60
X^2					**21.23**

Appendix 7: Comparison of Manual-Based versus IS-Based Processes

	Optimisation Challenges	Manual-Based	Information Systems
1	On-Time Delivery	1. Manual scheduling of deliveries not factoring in traffic, most optimal route to be taken or efficiently consolidating deliveries resulting in reduction in on-time delivery.	1. Visibility of live tracking of deliveries meaning more efficient management of customer service if any deliveries will be delayed. 2. Better planning routes based on algorithms and historical traffic allowing for improved on-time delivery.
2	Routing and Scheduling	1. No efficient way to schedule routes optimally. 2. Reliant on human judgement for scheduling of deliveries. 2. Room for human error.	1. Efficient routing and planning based on algorithms. 2. Traffic history taken into account. 3. Increase in vehicle utilisation proves better scheduling of deliveries. 4. Reduction in vehicles proves improved scheduling.
3	Customer Expectations and Service levels	1. Poor on-time delivery can reduce customer service levels.	1. More efficient planning of trips improves service levels as on-time deliveries improve as per customer's expected delivery dates. 2. Greater visibility of planned versus actual delivery times allowing improvements and adjustments to be made to meet customer expectations.
4	Transport Costs	1. Transport costs can increase due inefficent scheduling of deliveries as traffic and the most optimal route are not considered by the planner. 2. Not having the most optimal route can increase in fuel usage per vehicle. 3. Vehicle utilisation not proper managed resulting in higher number of vehicles.	1. With an increase in fuel costs, scheduling of deliveries are more optimal by ensuring the most efficient route is taken. 2. Vehicles are planned better therefore increased vehicle utilisation and eventually a reduction in vehicles.
5	Productivity	1. Paper-based processes require more time and effort from individuals resulting in a less productive environment.	1. Reduction in the scheduling time by the system. 2. Single view all tasks to be scheduled. 3. New orders are received almost immediately through the use of integration.
6	Sustainability	1. The use of Excel or paper-based process can result in paper being printed for the driver to complete deliveries.	1. The use of IS can result in a paper-less environment where the scheduled plan and sign-on glass are all completed on mobile devices.
7	Tracking of Deliveries	1. No proper visibility of current position of vehicles and deliveries.	1. Live tracking of actual deliveries improving the measurement of planned versus actual scheduling. 2. Visibility of deliveries at all times. 3. Improved customer service by providing live updates of deliveries.
8	Reporting	1. Reporting to be on Excel with no proper intelligence. 2. Tedious and time consuming. 3. Errors can be made using Excel. 4. Data may not be readily available.	1. The use of databases and integration to allow for improved reporting based on the data from the IS. 2. Real time data available for improved reporting.

Appendix 8: As-Is Process of Company A



Appendix 9: To-Be Process of Company A