UNIVERSITY OF KWAZULU-NATAL

An Integrated Logistics Network to enhance Logistics Optimisation of the University of KwaZulu-Natal's, Off-Campus Resident Students' Transportation

by

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DECLARATION

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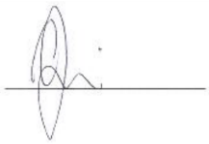
Signed: 

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ABSTRACT

The application of an integrated logistical network at the University of KwaZulu-Natal transportation system seeks to optimise the coordination of the movement of students in the University. The logistics network of the University of KwaZulu-Natal includes insourced and outsourced logistics services. This study is based on the nature of the University's student transportation system along with the phenomenon of an integrated network. The main purpose of this study is to explore the nature of the logistics network of the University by identifying its compatibility with the principles of integration. The objectives of this study are: firstly, to assess the influence of an integrated logistics network in optimising the transport services of the University. Secondly, to examine the effect of the process flow of the outsourced and insourced student transportation systems of the University. Thirdly, to establish the extent of the relationship between the transportation schedule and transport facilities. Finally, to assess the perceived performance outcomes of selected logistical systems against the expectation of the selected stakeholders.

This study applies the research onion that classifies research into five stages such as research philosophy, research approaches, research strategies, time horizons, and data collection methods. A quantitative approach has been adopted to analyse the data from 250 respondents. Using non-probability sampling, the purposive technique assisted to collect relevant data from persons of interest and knowledge. The study findings reveal the extent to which an integrated logistics network influences optimisation in the off-campus residents' transportation network of the University. Also, it reveals the perceived performance of the logistics network from the perspective of the students. Lastly, the study reveals a needed paradigm shift in meeting the transportation needs of off-campus resident students. This arises from the expressed dissatisfaction from students; it is also an opportunity for further incorporation of technology in the operational and managerial procedures within the logistics network of the University.

Keywords: Logistics Networks, Transportation, Integrated, Optimisation, Synchronisation

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

ANOVA	Analysis of Variance
B2B	Business-to-business
EDI	Electronic Data Interchange
E-hub	Electronic Hub
ERP	Enterprise Resource Planning
IT	Information Technology
KMO	Kaiser-Meyer-Olkin
LIS	Logistics Information System
MIS	Management Information System
MIT	Massachusetts Institute of Technology
PCA	Principal Component Analysis
RFID	Radio Frequency Identification
SCM	Supply Chain Management
SPSS	Statistics Package for Social Sciences
TMS	Transport Management System
UKZN	University of KwaZulu-Natal
VIF	Variance Inflation Factor

CHAPTER ONE
INTRODUCTION TO THE STUDY

1.1 Introduction

The University's student transportation and logistics strategy comprise a mixture of strategies that utilise in-house transportation and logistics facilities alongside outsourced facilities to support the operations of its various sectors such as colleges, inter-campus shuttle, and student housing. The use of both insourcing and outsourcing strategies by the University of KwaZulu-Natal has motivated this exploratory study, which aims to explore the influence of an integrated logistics network to optimise the logistics services of off-campus student transportation at the University.

1.2 Background Information

The logistics network of the University of KwaZulu-Natal is a mixture of insourced and outsourced logistics services. There are three main segments which are catered for by the student transportation network of the University which are namely, student housing, inter-campus transportation, and colleges. The University's transportation systems consist of a few categories with road mode of transportation each suitable for the carriage of designated items/people. The insourced transportation consists of University-owned transportation facilities. These vehicles are mainly utilised for fulfilling the transportation needs of various specific departments in the University. Nonetheless, the insourced vehicles can be utilised by other departments other than the designated. Outsourced transportation facilities include all vehicles that are owned by third parties; however, they serve the purpose of transporting the staff and students when commuting to and from the University. The University issues a tender to obtain transportation facilities for students dwelling in University organised off-campus residents. The transportation facilities are then operated according to a schedule which is designed to meet the transportation needs of students.

The need for logistical optimisation has been the main driver of the evolution of logistics itself over time. Optimisation is "a condition in which all functional units operate at an optimal level by considering all variables, dynamics, and constraints of the system" (Arayapan and Warunyuwong, 2010: 64). In this study, optimisation refers to "the maximisation of resources, minimisation of total logistics costs, and logistics synchronisation" (Obioma, Nwaogbe, Omoke, Ubani and Ukaegbu, 2013:134). An integrated logistical network consists of "an information hub through which several facets of the logistical systems are connected" (De Brito, 2015: 862).

1.3 Research Problem

Integrated networks prevent a logistical system from being scattered, which in turn, prevents wastage and enhances optimisation within the supply chain. The application of integrated transportation networks at the University of KwaZulu-Natal can help improve the coordination and movement of students at the University. This study will focus on the movement of off-campus students using University- allocated transportation, provided through a transportation schedule. This study is based on the need to improve the University's student transportation systems along with the need for an integrated network. A poorly structured transportation schedule results in poor transportation timeliness and inadequately caters to students' needs.

1.4 Research Questions

- To what extent does the process flow influence the outsourced and insourced student transportation systems at the University?
- Would an integrated logistics network influence in optimising the logistics services at the University?
- To what extent does transport facilities influence the transportation schedule?
- How do the perceived performance outcomes of selected logistical systems meet the expectations of the selected stakeholders?

1.5 Research Objectives

- To examine the effect of the process flow of the outsourced and insourced student transportation systems of the University.
- To assess the influence of an integrated logistics network to optimise the transport services of the University.
- To establish the extent of the relationship between transport scheduling and transportation facilities.
- To compare the perceived performance of selected logistical systems against the expectation of the selected stakeholders.

1.6 Preliminary Literature Review

The preliminary literature review provides an overview and structure of the literature to be reviewed later in the study. Various topics are discussed to vindicate the concepts unpacked in the study.

1.6.1 Logistics Networks

In a general sense, a logistical network is "a group of warehouses, transportation facilities, suppliers and manufacturing plants organised to accomplish the procurement of resources, their conversion into final products, and the distribution of final products to customers" (Bhoyar, 2013: 284). Therefore, a logistics network is made up of various organisations that interact through transportation flows (Pishvaee, Farahni, and Dullaert, 2010). Logistics networks are defined by the natural settings of individual entities and industries in terms of their logistics requirements (Pontius, 2015: 287). In a service industry (such as the University of KwaZulu-Natal), a logistics network may be constituted by suppliers and customers of suitable transportation facilities (Bhoyar, 2013: 283).

1.6.2 Logistics System Integration

Integrated logistics can be explained as "the process of identifying user's wants and needs, acquiring the people, materials, capital, information and technologies compulsory to meet those wants and needs; optimising the network of resources and utilising the network to fulfil users requests in a timely manner" (Nenni, 2013: 2). A strong transportation arm can be a backbone of a properly functioning supply chain, as integration is continuously ventured into for attainment of higher performance. To optimise a logistics system; there are two strategic focus areas of integration that must be considered, namely, vertical integration and horizontal integration (Arayapan and Warunyuwong, 2010).

1.6.3 Horizontal Integration

A logistics system can be enhanced drastically by means of implementing a horizontal integration strategy. Horizontal integration refers to collaboration between sub-units of an organisation (Goldsby and Martichenko, 2005). Various sub-units can be integrated by eliminating business unit silos in an attempt to optimise the logistics system (Vanelslander, 2010). According to Arayapan and Warunyuwong (2010), such integration results in the enhancement of flexibility in the total system. The barriers that hamper integrating organisational procedures are the staff inconsistencies and system constraints (Jayaram and Tan 2010). Therefore, a joint understanding of occurrences such as

human errors among business units will generate more effective conclusions and positive outcomes for an organisation.

1.6.4 Vertical Integration

Several wastes such as oversupply can be a consequence of bad association along with a supply chain (Jayaram and Tan 2010). A vertical integration refers to collaboration between multiple supply chain partners. Vertical integration enhances relationships along the supply chain. The main inputs of such integration are trust, information-sharing and communication (Vanelslander, 2010). Pieces of information that are not shared may lead to a bullwhip effect which may hamper many participants in the logistics network (Naude and Badenhorst-Weiss, 2011). As a result, a substantial amount of information planning is required to optimise the system. Despite high-quality information-sharing, it is recommended that the supply side should set their procedures at a high level of variability to cope with any market uncertainties (Arayapan and Warunyuwong, 2010).

1.7 Logistics Optimisation

The principle of optimisation is minimising or maximising a measurable objective function by altering values of a set of measurable constraints (Arayapan and Warunyuwong, 2010).

1.7.1 Total Logistics Cost Minimisation

An integrated logistics system is a complicated network within which all functional units have interactions. Due to the complexity of the network, all costs are quite challenging to determine as some are implicit costs. The total cost is the total of explicit and implicit costs (Arayapan and Warunyuwong, 2010). Explicit costs are made up of quantifiable expenses such as transport costs (Obioma *et al.,* 2013), whereas implicit costs are costs an organisation does not incur directly such as the opportunity costs of idle equipment (Obioma *et al.,* 2013). There are several ways to determine opportunity cost which management must consider when creating organisational strategies. Generally, the purpose of optimisation is to minimise cost. All things considered, the total cost reflected from integrated activities ought to be applied to improve the entire system rather than using the calculation based on a single unit task to reach strategic decisions (Flynn, Huo and Zhao, 2010). This process needs to be incorporated and understood throughout the organisation. In some instances, costs may be increased in other sections of the logistics network to shrink the cost of the whole system (Flynn *et al*., 2010). When incorporation is done, then logistics costs can be managed effectively from a single location (Arayapan and Warunyuwong, 2010).

1.7.2 Logistics Performance Maximisation

For logistics performance to be enhanced, the current level of logistics performance needs to be ascertained (Vedpal and Jain, 2011). The desired level of logistics performance is then determined. For these events to occur, logistics performance needs to be measured and evaluated appropriately. Vedpal and Jain (2011) point out that for many organisations, there are too many performance measures and that many of them may be obsolete and inconsistent. It is therefore vital that appropriate indicators or measures are selected to ensure that performance is measured effectively.

1.7.3 Logistics Network Synchronisation

Synchronisation is a broad term that "is defined distinctively in various contexts ranging from physics, biology and chemistry. Synchronisation is defined as the capability of entities of different natures to form a common operation regime due to interaction or forcing" (Windt, 2014:142). In logistics, this term is used in a wide sense as a phenomenon which aims to improve efficiency by coordinating demand and supply over time and space (Windt, 2014).

1.8 Theoretical Framework

The definition of dynamic capabilities is "the capacity to renew competencies to achieve congruence with the changing business environment" by "adapting, integrating, and reconfiguring internal and external organisational skills, resources, and functional competencies" (Teece, Pisano, and Shuen, 1997). Newer definitions by Helfat, Finkelstein, Mitchell, Peteraf, Singh, Teece and Winter (2007:515) have described dynamic capabilities as "the capacity of an organisation to purposefully create, extend or modify its resource base". The University of KwaZulu-Natal's student transportation resource base has a spectrum of logistical resources allocated for the sole purpose of transporting off-campus residence residing students. These resources range from UKZN outsourced shuttles to UKZN owned buses, which are utilised for students.

The dynamic capability perspective considers how valuable, rare, difficult to imitate and imperfectly substitutable resources can be created and how the current stock of valuable resources can be refreshed in changing environments (Helfat *et al.*, 2007). As observed at the University of KwaZulu-Natal, the student transportation resource pool comprises of buses. Through applying the dynamic capabilities framework, this study aims to highlight the potential to leverage the utilisation of such the resource base. The concept of dynamic capabilities emerged in the 1990s, and the field has advanced considerably since then (Helfat *et al.*, 2007).

Dynamic capabilities are said to encompass four main procedures: leveraging, reconfiguration, integration and learning (Bowman and Ambrosini, 2003 based on Teece *et al.*, 1997). These processes can be further considered in greater detail. They form the tenets of the theory of dynamic capabilities.

1.9 Significance of the Study

This study focuses on an integrated logistics network strategy to optimise the transportation systems of the University of KwaZulu-Natal. It investigates the extent to which an integrated network can contribute to maximum utilisation of transportation equipment. It examines the efficiency of the transportation systems and explores the state of the current performance of the University of KwaZulu-Natal's student transportation systems. The study aims to contribute to the improvement of efficiency of the transportation system at UKZN, which may lead to the improvement of the lives of off-campus residing students, and in turn, contribute positively to their efficient commuting to and from campus. Logistics is one of the major costs of doing business in the modern business environment in South Africa (Ittmann, 2010). Optimisation of logistics enables entities to execute the

logistics functions as cost-effectively as possible while being as institutionally effective as possible. The University, like other institutions, is constantly looking for ways to improve cost efficiency, and this study is hoped to contribute positively towards this quest (Mail & Guardian 15 January 2016, 2015:3).

1.10 Research Methodology

Saunders, Lewis and Thornhill (2009) present the concept of the research onion, which is a simplified representation of research. It classifies research into five stages, namely research philosophy, research approaches, research strategies, time horizons and data collection methods (Saunders *et al.*, 2009).

1.10.1 Research Philosophy

Research philosophy helps to clarify research design in terms of how research is interpreted and how it becomes useful in answering research questions (Saunders *et al*, 2009). It also helps to understand the overall parameters of the study. There are three main philosophical standpoints as depicted in Saunders *et al.*, (2009) research onion these are namely positivism, realism, and 'interpretivism'. This study adopted the positivist approach which requires that a subject under analysis should be measured by objective methods rather than subjective methods. Positivism is "an epistemological position which requires an observable social reality be worked on and is thus an objectivist ontology" (Saunders *et al.*, 2009:85).

1.10.2 Research Design

The research design adopted for this study was to employ an exploratory case study strategy using a cross-sectional approach. Exploratory studies are suitable whereby there is no knowledge regarding the situation at hand and there is limited availability of information on how similar research issues have been unravelled previously (Sekaran and Bougie, 2013). In case of studies, the case is the individual, group, organisation, event, or situation that the researcher is interested in (Sekaran and Bougie, 2013).

1.10.3 Research Approach

This study adopted a quantitative research approach. Data were collected and analysed using a quantitative method for the research problem to be understood properly (Saunders *et al.*, 2009). The quantitative research is hoped to clarify the relationships among the measured variables, developing meaning from the data that are represented through statistical analytical tools (Sekaran and Bougie, 2012).

1.10.4 Study Site

The study was carried out in Durban, KwaZulu-Natal at a campus of the University of KwaZulu-Natal. The University of KwaZulu-Natal (Westville) has off-campus residences which were selected as items of study in this research.

1.10.5 Target Population

Population refers to the full target respondents from which a sample is taken (Sekaran and Bougie, 2012). The target population of this study consisted of the students residing in the off-campus residences of the University of KwaZulu-Natal Westville. The off-campus residences accommodate approximately 713 students (UKZN, 2016).

1.10.6 Sample

A sample may be defined as a subset of the population (Saunders *et al*, 2009). The sample for this study consisted of students residing in the (University organised) off-campus residences of the University of KwaZulu-Natal.

1.10.7 Sampling Techniques and Sample Size

The study was carried out at the University of KwaZulu-Natal Westville campus. The sampling frame consisted of various off-campus residents (Sekaran and Bougie, 2012). In order to adequately understand students' views regarding the efficacy of the shuttle service offered by the University, one needs to employ a quantitative approach. Thus, for this purpose, this aspect of the study adopted purposive sampling (Gill and Johnson, 2010). Purposive sampling is utilised when researchers are required to obtain specific information from knowledgeable stakeholders. The sample size was 250 off-campus residing students according to Sekaran (2003) table.

1.11 Data Collection/Instrument

Self-administered questionnaires were hand delivered to the appropriate respondents for collecting quantitative data. Closed-ended questions were used in the structured questionnaire to collect as much as possible relevant data.

1.12 Data Analysis Methods/Analytic techniques

This study used SPSS version 22 to capture data and carry out the analysis. Data output from the statistical software included measures of central tendency and dispersion. The data were then displayed in the form of depictions and models to enable the analytical process (Gill and Johnson, 2010). The data conclusions drawn from the data analysis were checked for reliability (Cronbach Alpha) and validity (Content validity).

1.13 Ethical considerations

This study was designed in such a way as to conform to ethical standards and guides, which were made available through the University Research Ethical Policy. Permission was obtained from the University to carry out the research. Consent from all data sources was obtained prior to any interactions for data collection. The researcher has sought to obtain approval from all participants of the study.

1.14 Conclusion

The study was introduced providing an outset for the study. Important concepts that will transcend throughout the study were outlined. The background of the study was also covered in order to outline the context of the study. The objectives of the study, as well as research questions, were also outlined, these will be addressed throughout the study. A brief overview of the research methodology was discussed outlining all components.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This study is underpinned by the theory of dynamic capabilities. The optimisation of the logistics network through integration is a focal point of this study. Optimisation entails the improvement of operations in terms of costs and performance amongst other aspects (Arayapan and Warunyuwong, 2010). The theory of dynamic capabilities serves as the lenses through which this study is undertaken. The theory of dynamic capabilities considers aspects such as reconfiguration, leveraging, learning and integration (Bowman and Ambrosini 2003 based on Teece, Pissano and Shuen, 1997). The aspects covered by the theory of dynamic capabilities are inclusive of the minimisation of costs and maximisation of performance through integration which is a primary point of interest for this study.

2.2 Theoretical Framework

The definition of dynamic capabilities is "the capacity to renew competencies to achieve congruence with the changing business environment" by "adapting, integrating, and reconfiguring internal and external organisational skills, resources, and functional competencies" (Teece *et al*., 1997). Newer definitions by Helfat, Finkelstein, Mitchell, Peteraf, Singh, Teece and Winter, (2007:515) have described dynamic capabilities as "the capacity of an organisation to purposefully create, extend or modify its resource base". The University of KwaZulu-Natal's student transportation resource base has a spectrum of logistical resources allocated for the sole purpose of transporting off-campus residence residing students. These resources range from UKZN outsourced shuttles to UKZN owned buses which are utilised by students.

The dynamic capability perspective considers how valuable, rare, difficult to imitate and imperfectly substitutable resources can be created and how the current stock of valuable resources can be refreshed in changing environments (Helfat *et al.*, 2007). As observed at the University of KwaZulu-Natal, the student transportation resource pool comprises non-uniformed buses. By applying the dynamic capabilities framework, this study aims to highlight the potential to leverage the utilisation of such a resource base whilst considering the aspects of non-uniformity. The concept of dynamic capabilities emerged in the 1990s, and the field has advanced considerably since then (Helfat *et al.*, 2007).

Dynamic capabilities are said to encompass four main practices: leveraging, reconfiguration, learning and integration (Bowman and Ambrosini, 2003 based on Teece *et al.*, 1997). Bowman and Ambrosini (2003:290) state that "Reconfiguration refers to the transformation and recombination of assets and resources, the consolidation of manufacturing resources that often occurs as a result of an acquisition". Leveraging is the duplication of a procedure or system that is functioning in one area of an entity in an alternative area, or spreading a resource by arranging it in a new domain. An example of leveraging can be seen when applying an existing brand to a new set of products (Bowman and Ambrosini, 2003). As a dynamic capability, learning allows tasks to be performed with the best potential, often as a result of the investigation and permits reflection on failure and success (Bowman and Ambrosini, 2003). Finally, integration states the capability of the entity to integrate and coordinate its resources, resultant to the advent of a new-fangled resource base (Bowman and Ambrosini, 2003).

The theory of dynamic capabilities can be used to examine logistics network integration, optimisation of processes in the logistics system and opportunities for technological improvement. This is going to be carried out through touching base on the tenets of dynamic capabilities, which include reconfiguration, leveraging and learning.

2.3 Logistics and Transportation Networks

In a general description, a logistical network is a group of warehouses, transportation facilities, suppliers and manufacturing plants organised to accomplish the procurement of resources, their conversion into final products, and the distribution of final products to customers (Bhoyar, 2013). Therefore, a logistics network is made up of various organisations that interact through transportation flows (Pishvaee *et al*., 2010). Logistics networks are defined by the natural settings of individual entities and industries in terms of their logistics requirements (Pontius, 2015). In a service industry (such as the University of KwaZulu-Natal), a logistics network may be constituted by suppliers and customers of suitable transportation facilities and their clients (Liu, Yang, Wu, and Zheng, 2012). In the context of the University of KwaZulu-Natal's off-campus residence residing students; the network comprises buses – University and privately owned. These buses serve to transport under various pretexts which include off-campus residence students, and students travelling for academic reasons. The sum total of these buses along with the routes on which they operate describes the parameters of the student transportation network of the University of KwaZulu-Natal.

The concept of transportation and logistics network design comprises ascertaining the locations (nodes), pathways (routes) and the resources to facilitate the process of transportation (Liu *et al*., 2012). The optimal configuration of the network needs to have the capability to deliver an efficient service to customers and also satisfy the service level requirements. Therefore, outsourced logistics services providers need to be capable of designing networks that are efficient and cost-effective when serving their clients (Liu *et al*., 2012). To be considered the best alternative to insourcing, efficiency and effectiveness need to be attained by the third-party logistics providers.

2.3.1 Trends in Transportation Strategy

Recent studies have demonstrated that the industry of outsourced logistics continues to gain popularity amongst entities. This is also demonstrated by growing aggregate global revenues for third-party logistics providers (Tsai, 2012). Notably, the number of entities that utilise third-party logistics services has grown by approximately sixty-five per cent compared to twenty-two per cent of entities that have returned to insourcing (Sangam, 2013). More than half of current entities utilise outsourced logistics services for the sole purpose of transportation. Amongst other logistics functions, transportation is found to be one of the most popular services in outsourcing (Gonzalez-Loureiro, Dabic and Kiessling, 2015).

Overall, global studies suggest that a lot more entities are increasing their amount of logistics outsourcing on average yearly than the ones that return to utilising in-house logistics services. The dimensions of insourcing and outsourcing movements tend to remain on a stable trajectory. More and more entities are moving towards outsourced logistics services, which is in-line with increased revenues for third-party logistics services providers (Miranda, 2015).

On the other hand, insourcing remains less popular amongst entities. Global studies have shown that only twenty-two per cent of the entities have returned to insourcing the majority of their logistics activities (Stojanovic, 2012). The European markets alone have shown significant changes in terms of the amount of insourcing of transportation activities (Sabet, Yazdani and De Leeuw, 2017). Figures show remarkable changes from year to year when juxtaposed with the rest of the world. The decision between insourcing and outsourcing of logistics activities rests upon an array of consequences for the entities. As shown by global statistics, this particular decision is not simple and straightforward. There are various justifications for entities when opting for either an insourced or an outsourced logistics network.

2.3.2 Insourcing Logistics and Transportation

As much as general major trends amongst entities point towards outsourced logistics services being the prevalent option, there are still entities that opt not to appoint third-party logistics suppliers, but to maintain control of their logistics affairs internally (Wan, 2015). This decision typically germinates from the high complexity of supply chain and logistics related requirements (Tsai, 2012). Whilst still unpopular, entities choose to insource for various industries related reasons. Some organisations regard logistics as one of their core competencies (Wan, 2015). In this case, an entity maintains according to its own standard, the best level of efficiency. The entity regards logistics as one of the tenets of its operations. In some cases, it is found that naturally, an entity may have in-house expertise that surpasses that of most third-party logistics providers (Tsai, 2012). In these instances, entities may also often find themselves even supplying others with such activities. This is common when entities have a large pool of logistics resources.

When logistics functions are too complex, entities are more likely to utilise in-house logistics resources (Tsai, 2012). The business model of most third-party logistics providers is centred on standardised processes and economies of scale. In instances whereby, an entity has highly complex requirements for logistics, outsourcing becomes less appealing. Some entities have a high level of understanding with regards to their business procedures, which is less likely to be achieved by a third party (Wan, 2015). Aside from the high complexity of logistics activities and higher in-house expertise in logistics, an extensive understanding of the procedures of an entity is required. If such a high level of understating of a specific industry cannot be located outside the entities, then insourcing is most likely to be employed.

The difficulty to integrate information flows and systems between an entity and a third-party logistics services may curb the relationship between existence (Stojanovic, 2012). The incompatibility of systems normally boils down to no formation of relationships. The relationships are not formed as a result of a lack of foundation. If the view that outsourcing reduces logistics costs does not resonate in an entity, insourcing is likely to be the strategy of choice (Tsai, 2012). Entities are constantly chasing lower operating costs; therefore, the strategies that promise to deliver lower costs are usually selected. The macro-environmental factors such as the political climate may be discouraging towards outsourcing. Labour unions and outsourced employees in major organisations are disputing to serve as part of independent contractors' labour force. The pressures that come from such a climate may outweigh the benefits of outsourcing in some cases. This factor and others, therefore, may render insourcing as the best option for an organisation.

There are a number of drawbacks and benefits that go with the decision of insourcing (Wan, 2015). Many organisations that choose to insource are willing to sacrifice the potential cost savings and many other benefits that are supplementary to a successful outsourcing relationship. Entities benefit in terms of conserving control and avoiding uncertainty related to their logistics processes (Tsai, 2012). In other cases, insourcing is preferred on the basis of avoiding the effects of an unsuccessful outsourcing relationship (Stojanovic, 2012). Crucial information gets closely monitored and protected as a result of an insourcing decision (Wan, 2015). Through insourcing, several outsourcing risks are mitigated. Major drawbacks of the decision of insourcing include the potentially significant cost savings that are not realised. The level of flexibility is also believed to be reduced (Wan, 2015). Logistics insourcing entities are believed to lose out on a higher level of logistics specialist expertise, including a reduced level of logistics technology (Stojanovic, 2012). Entities that insource their logistics functions are also believed to incur a high amount of fixed costs (Stojanovic, 2012).

2.3.3 Outsourcing Logistics and Transportation

The decision to outsource is seen to be the most popular as a result of its major costs saving potential; however, there are several other reasons beyond the monetary reasons. Other reasons include the degree of the velocity of an entities supply chain, and the expectations and demands of the consumers (Marasco, 2008). There are several other aspects that may cause outsourcing to be more appealing to entities. As specialists, third-party logistics possess more expertise, which therefore warrants them with a high-level efficacy when executing activities. The service levels are maintained to the highest standard when specialisation is involved. Opposite to insourcing, outsourcing enables entities to leverage a higher level of technology and level of technical expertise (Rahman, 2011).

Entities are afforded the opportunity to focus on their key competencies through successful outsourcing relationships. This means that an entity can, therefore, deploy more time resources on strategic excellence. This would, therefore, have a positive effect on overall performance. Through the appointment of a third-party, entities avoid the burden of extra capital investments on logistics equipment and facilities (Ramanathan and Ramanathan, 2014). These commitments include long-term leases and or facilities maintenance related costs. Entities are then freed from any equipment related implicit costs.

Third-party logistics companies operate with a pool of resources, which is spread across numerous clients (Sabet et al., 2017). This, therefore, enables outsourcing to have the ability to cope with fluctuating demand otherwise not simple to cope with. Entities evade their capacity constraints through outsourcing. Outsourcing helps entities to thin out the amount of staff employed, thereby

reducing the burden of workforce issues (Sabet *et al*., 2017). Employing higher amounts of staff means having to cope with various staff related issues such as strikes, compensation and other labour concerns. Various staff members in an entity belong to different labour unions and other regulations and compliance agencies, whose responsibility is lifted from an entity through outsourcing.

After the decision to outsource has been made and justified, there are several drawbacks and benefits to it (Abdallah, Diabat and Simchi-Levi, 2012). The parameters of successful outsourcing relationships are clearly defined with intense planning and execution. These relationships are rooted in collaboration, trust and integration between parties. Benefits of outsourcing include a reduced level of capital and operating costs. An increased level of flexibility and adaptability can also be achieved through outsourcing. Collectively, the benefits of outsourcing boil down to an improved customer service (Abdallah *et al*., 2012). One of the great drawbacks is the perceived loss of control over logistics activities (Cheng and Lee, 2010). A high dependence on third-party logistics services providers can create challenges for an entity. Outsourcing entails the sharing of human resources; this may become problematic because of clashes in organisational culture (Cheng and Lee, 2010). The level of confidentiality may also be compromised as a result of outsourcing.

2.3.4 Integrating Logistics through Outsourcing

Third-party logistics is the most popularly accepted business practice. New age organisations are now outsourcing a single partner to build, design, assess, run and measure comprehensive integrated supply chain solution on their behalf (Jayaram and Tan 2010). Such relationships are also known as fourth-party logistics (Jayaram and Tan, 2010). Fourth-party logistics providers are known to be supply chain integrators. They assemble all available resources, technology and capabilities of an organisation and its array of providers in a supply chain.

Fourth-party logistics services providers are non-asset based operators who offer outsourced services assessing supply chains wholly (Abidi, de Leeuw and Klumpp, 2015). Fourth-party supply appoints the most capable asset-based services providers to carry out the task of delivering the required services, as per the customer organisation's needs. Fourth-party logistics services providers are also seeking to reduce their customers' total while driving efficiency forward (Abidi *et al*., 2015).

Fourth-party logistics services providers are outsourcing specialists who are assigned for the optimisation of their client's entire logistics function (Wan, Wang, Lin, and Dong, 2015). For the most part, the focus is not only on reducing the daily logistics costs such as transportation amongst others, but also the management of logistics activities, and their optimisation (Wan *et al*., 2015).

Fourth-party logistics services providers are suitable for long-term partnerships as they are openly linked with an organisation's strategy.

The fourth-party logistics provider coordinates and manages the relationships and activities of an organisation. This, therefore, means that the fourth-party logistics services provider takes on the responsibility of a strategist who can manage various assets that are related to the organisation. Fourth-party logistics services providers cover most aspects of logistics networks integration, optimisation and synchronisation.

2.4 Logistics Network Integration

Integrated logistics can be explained as "the process of identifying users' wants and needs, acquiring the people, materials, capital, information and technologies compulsory to meet those wants and needs; optimising the network of resources and utilising the network to fulfil users' requests in a timely manner" (Nenni, 2013: 2). A strong transportation arm can be a backbone of a properly functioning supply chain; as integration is continuously ventured into for attainment of higher performance. To optimise a logistics system, there are two strategy focal areas of integration that must be considered, namely vertical and horizontal integration (Arayapan and Warunyuwong, 2010).

Integrated logistics networks are to comprise joint management of logistics functions such as having a joint establishment of decisions, objectives, planning, and information sharing (Li, Taudes, Chao, and Hanping, 2011). Reconfiguration of management to facilitate integration can be realised at the two interconnected levels, which are internal (horizontal) and external (vertical) integration.

2.4.1 Horizontal Integration

An internal integration of logistics activities has to do with activities in other functional units of a given firm such as various departments within an organisation (Nenni, 2013). A logistics system can be enhanced drastically by means of implementing a horizontal integration strategy. Horizontal integration refers to collaboration between sub-units of an organisation (Li *et al*., 2011). Various sub-units can be integrated by eliminating business unit silos in an attempt to optimise the logistics system (Vanelslander, 2010). According to Arayapan and Warunyuwong (2010), such integration results in the enhancement of flexibility in the total system. The barriers that hamper integrating organisation procedures are the staff inconsistencies and system constraints (Arayapan and Warunyuwong, 2010). Therefore, a joint understanding of occurrences such as human errors among business units will generate more effective conclusions and positive outcomes for an organisation.

2.4.2 Vertical Integration

Several wastes such as oversupply can be a consequence of bad association along with a supply chain (Arayapan and Warunyuwong, 2010). Vertical integration refers to collaboration between multiple supply chain partners. It enhances relationships along the supply chain. The main inputs of such integration are trust, information-sharing and communication (Vanelslander, 2010). Furthermore, vertical integration helps reduce administrative work, improves the accuracy and continuity of the flow of information, and facilitates joint implementation and planning (Nenni, 2013). Pieces of information that are not shared may lead to a bullwhip effect, which may hamper a number of participants in the logistics network (Naude and Badenhorst-Weiss, 2011). As a result, a substantial amount of information planning is required to optimise the system. In spite of high-quality information-sharing, it is recommended that the supply side should set their procedures at a high level of variability in order to cope with any market uncertainties (Arayapan and Warunyuwong, 2010).

An integrated logistics network can be seen as an effective tool in overcoming high logistics costs (Vanelslander, 2010). Nonetheless, for the achievement of nearer relationships that produce the promised benefits, the stakeholders have to cultivate a high level of commitment, dependence and trust. Support from high-ranking management, trust, the capability of meeting performance expectations, setting clear goals and compatibility of partners are important factors for the realisation of critical relationships (Nenni, 2013).

2.5 Logistics Network Optimisation

The principle of optimisation is minimising or maximising a measurable objective function by altering values of a set of measurable constraints (Pahl, Reiners, and Voß, 2011). According to (Goldsby and Thomas, 2005), there are two strategic focus areas through which logistics systems may be optimised which are; integration (horizontal and vertical), and total cost minimisation. Optimisation techniques contribute immensely in finding optimal solutions in a logistics network.

2.5.1 Total Logistics Cost Minimisation

An integrated logistics system is a complicated network within which internal and external organisational functional units have interactions. Due to the complexity of the network, all costs are quite challenging to determine, as some are implicit costs. The total cost is the total of explicit and implicit costs (Pahl *et al.,* 2011). Explicit costs are made up of tangible expenses such as transport costs (Obioma *et al.,* 2013), whereas implicit costs are costs an organisation does not incur directly such as the opportunity costs of idle equipment (Obioma *et al.,* 2013).

Explicit costs can also be described as traceable or ascertainable costs that are concrete and observable from an organisation's financial statement (Zhu and Xiuquan, 2013). In terms of logistics, explicit costs comprise items such as transportation, personnel and the actual costs that are directly linked to the process of logistics (Obioma *et al.,* 2013). In broader logistics contexts such as in warehousing and inventory management, these costs may be costs such as rework, scrap, shrinkage, taxes, obsolescence, inventory damages and insurance.

As much as many of the examples of explicit (visible) costs mentioned above can be predetermined and ascertained, in many organisations, they cannot (Lin, 2014). Organisations recognise explicit logistics as necessary when conducting their daily business. The capability of continuously shrinking these costs is crucial as it can be one of the ways to determine top performers in industrial competition (Lin, 2014).

Implicit costs are the hidden costs, which are not directly reflected on organisations financial instruments, yet they cannot be avoided because they represent opportunity cost when funds are allocated in an organisation (Zeng, 2012). Opportunity cost is the value that is foregone in order to attain something else (Beuthe, 2001). For a process to be deemed as worthwhile, the least opportunity cost should be incurred as a result. There are various standpoints from numerous schools of thought for calculating the cost of lost opportunity (Beuthe, 2001). Financial management specialists have it as a consensus that financial losses because of lost opportunity would range somewhere between an organisation's risk-adjusted rate of return on equity (also known as the weighted average cost of capital) and the actual cost of capital (Zeng, 2012). Notwithstanding the methods used to ascertain, the cost of lost opportunity such as idle time of equipment is incurred by organisations and it is crucial that these costs are taken into consideration during the strategic decision-making process.

There are many ways to determine opportunity cost which management must consider when creating organisational strategies. Generally, the purpose of optimisation is to minimise cost. All things considered, the total cost reflected from integrated activities ought to be applied to improve the entire system rather than using the calculation based on a single unit task to reach strategic decisions (Wang, Lai, and Shi, 2011). This process needs to be incorporated and understood throughout the organisation (Wang *et al.,* 2011). In some instances, costs may be increased in other sections of the logistics network in order to shrink the cost of the whole system (Piplani and Saraswat, 2012). When incorporation is done, then logistics costs can be managed effectively from a single location (Piplani and Saraswat, 2012).

2.5.2 Logistics Performance Maximisation

For logistics performance to be enhanced, the current level of logistics performance needs to be ascertained (Vedpal and Jain, 2011). The desired level of logistics performance is then determined. For these events to occur, logistics performance needs to be measured and evaluated appropriately. Vedpal and Jain (2011) point out that for many organisations, there are too many performance measures and that many of them may be obsolete and inconsistent. It is therefore vital that appropriate indicators or measures are selected to ensure that performance is measured effectively. In the context of transportation networks, performance measure germinates from two aspects; these are time and cost. The time aspect has to do more with the reliability of a transport network. It considers issues such as turnaround time, cycle time, lead-time and average travel time (Vedpal and Jain, 2011). On the other hand, the cost aspect also covers the matters of the reliability of the transport network. This also includes the average operating costs of a transportation network.

The most successful organisations are said to pursue the capability to identify the consumers' needs and to execute them accurately on a timely fashion and also to do so consistently and reliably (Chanintrakul, Mondragon, Lalwani and Wong, 2009). It is also observed that organisations often sacrifice the quality of their logistics service in pursuit of speed (Win, 2008). A time-based focus towards performance maximisation is called "time compression" (Chainintrakul *et al.*, 2009). Time compression takes into consideration time-based strategic objectives. This strategy identifies all value-adding activities alongside eliminating those activities that do not add value to the ultimate customer satisfaction.

Time compression strategies include processes simplification, process integration by means of improved information and shorter linkages between processes (Danese, 2013). It is important that the best practices are standardised while variances are closely monitored. Challenges within systems also need to be detected and corrective action taken early. Time compression strategies may also be aided by automated information flows for enhanced efficacy, adjustment and allocation of resources and careful planning (Chainintrakul *et al.*, 2009).

2.5.2.1 Transportation System Performance

A logistics network's capability to meet its users' requirements can be evaluated using key performance indicators. Key performance indicators can be based on principles that stem directly from policy goals and network requirements. According to Flynn *et al.*, (2010), the following key performance indicators represent sustainable mobility.

- Health and Safety requirements.
- Travel requirements of the users.
- Economic support.
- The minimisation of transportation costs for access and mobility.
- The minimisation of costs of infrastructure.
- Maintenance of security.
- Ensuring long-term viability of a transportation system.

The achievement of the fulfilment of key performance indicators results in a suitably operational transportation network. This would also address transportation network challenges such as congestion, overall quality in the transportation system, improvement in the ecological effects and improved traveller information handling capability (Flynn *et al*., 2010).

2.6 Logistics Network Synchronisation

Synchronisation is a widely used term, which is defined distinctively in various contexts ranging from physics, biology and chemistry. Synchronisation is defined as "the capability of entities of different natures to form a common operation regime due to interaction or forcing" (Becker, Chankov and Windt, 2014:595). In logistics, this term is used in a wide sense as a phenomenon that aims to improve efficiency by coordinating demand and supply over time and space (Becker *et al.*, 2014). Synchronisation is essential for integration as it is one of the most important pillars. Synchronisation can help to make the process of integration easier to facilitate as it echoes the importance of close ties between various functions.

2.6.1 Demand and Supply Coordination

Demand and supply are concepts of a market economic system that are used in order to explain the fundamental economic relationship between a consumer and a producer (Boysen, Briskorn, and Tschöke, 2013). Demand measures the willingness of the consumer in terms of quantity demanded and a cost that the consumer is willing to incur (Boysen *et al*., 2013). Supply, on the other hand, represents the willingness of a supplier in terms of the quantity supplied at a given gain for the supplier (Boysen *et al*., 2013). Consumers' willingness to pay is directly linked to their preferences, the nature of a commodity and alternatives (Metta and Badurdeen, 2011). Suppliers' willingness is dependent on the opportunity cost of supplying a commodity (Metta and Badurdeen, 2011). As explained by Adam Smith's theory of an invisible hand, producer and consumer negotiate through market forces for the best "market price" that is suitable for both parties (Pfohl, Kohler and Thomas,

2010). The market price is found at a point when demand and supply intersect, a point also known as "equilibrium". According to the market economic system theory, equilibrium is a point of utmost efficiency where there is no economic "deadweight loss" (Pfohl *et al*., 2010). In supply chain management, an equilibrium point represents a point at which waste is minimised given the view that producer and consumer are supply chain participants.

Supply Chain partners rely on each other for all kinds of resources, information resources in particular (Xu and Zhai, 2010). As per traditional definition, logistics is the process of planning, executing and controlling an effective and movement and storage of goods, related information, and services in their movement to the point of consumption from the source (Xu and Zhai, 2010). The level of complexity and uncertainty in logistics-related decision-making stems from customer diversification and requirements that differ in terms of resources requirements and unanticipated changes (Xu and Zhai, 2010). There is also variability amongst role players (customers and logistics providers) in terms of goal setting, and the planning of geographically isolated networks of multiple locations, which leads to a need to coordinate the process of logistics (Xu and Zhai, 2010).

The main challenge lies in the management process of a logistics network's complexities to generate significance for the customer and integrate the entire network with the aid of electronic communication (Özkır and Baslıgil, 2013). The logistics industry is characterised by a continuously changing technological environment, customer expectations, risk involvement and level of overall innovation (Özkır and Baslıgil, 2013). Teece *et al*. (1997) presented a system of dynamic capabilities approach to coordinate decisions of role players regarding the use of organisational resources. Coordination of network key role-players can result in overall better results and elevated financial performance across the supply chain (Boysen *et al*., 2013).

2.6.2 Demand and Supply Modelling

Assignment modelling is traditionally one of the elementary combinatorial optimisation methods of allocating organisational resources (Fink and Reiners, 2006). In transportation, assignment models are used to simulate links and flows of traffic. As a result of the simulation, basic performance measures can be examined such as travel time, congestion, and the usage of resources in the network. Assignment models are a simple method of designing and planning transportation networks in various settings. When designing these models, a fixed-state, which is self-reproductive, is sought. This state can be regarded as an "equilibrium" whereby supply-side and demand-side factors find balance (Zhang, Ruan, Liu, Wang, Wang and Wang, 2012).

In demand and supply modelling, the model can be relative to time, considering certain parts of a given day such as peak hours. When mathematically formulating the models to determine demand in a transportation network, aspects such as the elasticity of demand are also considered (Zhang *et al.*, 2012). Users are categorised according to their patterns in the usage of the network. The categories are viewed as classes that represent how certain groups utilise the network at given times of the day on a day-to-day basis. When mathematically calculating supply, assignment modelling takes the flow, cost and link-paths into consideration (Zhang *et al.*, 2012). The supply model is then used relative to time to determine the required facilities. The simulation of the interaction between demand and supply can be used to extract user knowledge, which can later be used to enhance the performance of the network. Through repeated use, in time, the models can be used in forecasting demand, supply and other factors that affect a transportation network (Zhang *et al.*, 2012).

2.6.3 Transportation Scheduling

In the planning phase of transportation network design, strategic decisions such as stop layout, route design and frequency determination are outlined (Bast, Carlsson, Eigenwillig, Geisberger, Harrelson, Raychev, and Viger, 2010). The functional decisions associated with creating a transportation schedule (timetabling) are the allocation of vehicles and the creation of work shifts for operators. The stimulus for suitable solutions to these functional decisions is the reduction of opportunity cost to the overall organisation (Bast *et al*., 2010). Since functional decisions are the primary determinants of the opportunity cost, defining suitable solutions has a direct effect on the organisational objectives (Bast *et al*., 2010). Frequently, these functional tasks are facilitated by technological tools that are programmed to create the best solutions in a short space of time, usually with direct engagement with those assigned to the planning decision.

2.7 Supply Chain Information Sharing

The current era is regarded as an “information age” in supply chain management. Accessibility of information is regarded as increasingly paramount for the past decade (Xu, 2011). The outburst of the availability of information has enabled key decision makers of supply chains a lot of avenues to explore opportunities for the enhancement of supply chain efficiency (Xu, 2011). The supply chain is powered by knowledge (information) like the instance of the saying “knowledge is power”. A better-informed decision maker has an upper hand among competitors. In addition, he/she has the capability to manage an organisation efficiently and effectively. Furthermore, he/she has the capability to triumph in an environment that is characterised by high complexity. There is a vital role that is played by information in the management of a supply chain as a whole (Oracle, 2015). The

manner in which a supply chain performs is highly dependent on the degree of coordination of decision making amongst players. The sharing of information can be viewed as the basis of coordination in supply chain management (Oracle, 2015). There are numerous developing innovative and technological methods of connecting supply chain members to back information sharing (Oracle, 2015). Developments that incorporate information systems and technology such as Enterprise Resource Planning (ERP) enable supply chain members to share information in the modern age (Oracle, 2015). ERP allows for a seamless sharing of information between organisations.

2.7.1 Supply Chain Information Systems

By its nature, supply chain management has a wide spectrum, which covers various types of partners. It also covers the management of resources such as physical, information and financial resources (Ramaa, Subramanya, and Rangaswamy, 2012). The flow of physical resources includes the movement of materials and also the transportation of people from point to point (Ramaa *et al.*, 2012). The flow of information covers the transmission of orders and the processing of transportation reports. The flow of financial resources, on the other hand, consists of the movement of payment schedules and credit terms (Bi, Davidson, Kam, and Smyrnios, 2013). In the Massachusetts Institute of Technology (MIT), Supply Chain Management can also be defined as a process-based, approach of integrated procurement, production and delivery of goods and services to consumers (Bi *et al.*, 2013). In other words, Supply Chain Management entails systems, methods, and leadership of continuous improvement of an organisation's integrated process of goods and services design, procurement, logistics, and the satisfaction of customers (Bi *et al.*, 2013).

In the case of management of multi-organisation integration in Supply Chain Management, organisations must plan large-scale enterprise applications to achieve the requirements of collaborative planning and execution of decisions (Leung, Lim, Tan, and Yu, 2012). The planning processes' focal points are demand forecasts, resource distribution, transportation, resources planning and scheduling (Leung *et al.*, 2012). Supply Chain planning software applications are designed for improving demand forecasting, resource simulation and distribution, resource planning and scheduling, and transportation (Leung *et al.*, 2012). The software is created to boost forecast accuracy, to optimise scheduling of resources, to reduce the cost of distribution and transportation, and to improve the overall customer satisfaction (Toyasaki, Wakolbinger and Kettinger, 2013). The process of execution, on the other hand, focuses on the procurement and distribution of goods and services throughout the supply chain (Toyasaki *et al.*, 2013). Supply Chain Execution software applications are created to handle the process of the movement of resources through various points

in the supply chain ensuring that the correct resources are delivered to the correct location with the use of the best transportation alternatives available (Toyasaki *et al.*, 2013).

According to Simchi-Levi (2008), there are several other objectives for Information Technology in Supply Chain Management beyond planning and execution. These include:

- The provision of the visibility and availability of information.
- Enabling of a single central point of communication for information or data.
- Enabling decision making to be supported by total supply chain information.
- Enabling integration and collaboration amongst supply chain partners.

Information Systems in Supply Chain Management enables various opportunities such as direct and operational benefits for the creation of strategic advancement (Barbosa and Musetti, 2010). They rearrange industry norms and structures amongst competitors. Information Systems and Technology are key enablers to organisations, which create a strategic advantage through enabling a centralised strategic planning with centralised daily operations (Barbosa and Musetti, 2010). The usage of Information Systems and Technology infrastructure also creates a more market-oriented supply chain.

2.7.1.1 Logistics Information Systems

As a function of Supply Chain Management, logistics is a component of SCM, which is concerned, with the physical movement of resources and people from point to point. Logistics information systems are considered to include Transportation Management Systems (TMS), vehicle scheduling and routing systems, Enterprise Resource Planning (ERP) systems, other Information Technology (IT) applications and Management Information Systems (MIS) that support logistics operations (Wood, Reiners, and Pahl, 2015).

2.7.2 Enterprise Resource Planning

Enterprise Resource Planning (ERP) software systems are utilised by organisations for the coordination of information across various parts of an organisation (Oracle, 2015). ERP software systems are to help management in organisation-wide processes. ERP systems use a common database along with management reporting tools that are shared (Oracle, 2015). ERP systems support effective and efficient organisation operation through integrated tasks related to various organisational business units (Fan and Jinliang, 2010). The element of timeous organisation-wide information sharing makes ERP popular in the supply chain management space (Jutras and Castellina, 2010). Supply Chain management tasks such as demand forecasting and general supply chain

optimisation can be integrated with the rest of the organisational tasks through the usage of ERP. In efforts to achieve supply chain optimisation, ERP can also be coupled with Electronic Data Interchange (EDI) and other internet-based applications (Jutras and Castellina, 2010).

2.7.3 Electronic Data Interchange

Electronic Data Interchange (EDI) is in simple terms a method of information exchange that occurs between computers in a standard electronic format between partnering organisations (Qiao, Chang, Hao and Kong, 2012). The removal of the paper or manual exchange of information bares benefits such as cost reduction, minimised processing errors, improved processing speed and enhanced overall relationships between partnering organisations (Qiao *et al.*, 2012). In the supply chain, EDI can be used to enhance decision making between supply chain players. Information-symmetric-based decisions enable supply chain optimisation (Momoh, Roy and Shehab, 2010).

2.7.4 Supply Chain Information Hub

Supply Chain Information hubs (E-hubs) serve as a single point of communication as mentioned by Simchi Levi (2008). They can be described as unbiased internet-based intermediaries with an industry-specific focus or specific organisational processes that host electronic interactions and use different market mechanisms to facilitate transactions amongst organisations (Jeeva and Wood, 2012).

Business-to-Business (B2B) e-hubs can also be described as exchanges or marketplaces, which is a concept that is characterised by vast amounts of potential (Jeeva and Wood, 2012). E-hubs can be applied to various industries and organisational functions to provide unique overlapping features. Industrial e-hubs facilitate the procurement and transactional processes, whereby functional e-hubs provide information exchange of transportation and logistics (Jeeva and Wood, 2012).

E-hubs are a growing phenomenon in SCM, therefore are subject to various forms of speculation on their industrial trajectory. As a result, they are continuously explored in modern-day supply chains. There is still a vast array of opportunity to explore limitations of existing e-hubs, and to explore the potential and value to organisations in the future. Bhandari (2012) have concluded that e-hubs will function as a control centre at organisational functional level. Supply Chain role players will be able to integrate their own operations with other organisational functions, channelling transactions, monitoring and executing in real time with various supply chain partners (Bhandari, 2012).

2.7.4.1 Transportation Information Hub

Transportation is the process of the physical movement of resources from point to point (Ebrahim-Khanjari, Hopp, Seyed, and Iravani, 2012). It is an industry that is mainly characterised by geographic dispersion and geographic diversification (Ebrahim-Khanjari *et al*., 2012). Time and Costs of services are the two major differentiating factors amongst various transportation service providers (Ebrahim-Khanjari *et al.,* 2012). When both these factors have been minimised, the overall value that is delivered to the customer is improved (Özer, Zheng, and Chen, 2011). Transportation transactions have great potential to save costs for an overall organisation. Industries have made efforts to adopt Transportation Management Systems (TMS) software earlier; however, market penetration was low for the software (Guanghua and Dong, 2015). A study conducted by the Kingsley Group Research (Bittner, 2001) found and concluded that TMS software could not provide a holistic solution for carriers and shippers. The TMS software packages have been reported to have significant barriers to their proper implementation (Ren, Cohen, Ho, and Terwiesch, 2010). Prevalent barriers such as substantial time consumption and high implementation costs and an absolute difficulty of integration have been detrimental and defeating in the adoption of TMS (Tenhiala, 2015). A successful transportation network is characterised by minimised implementation cost and minimised execution time, hence a traditional TMS software package cannot fulfil this purpose in a practical manner (Tenhiala, 2015). The elements of cost-effectiveness and timeliness can be salvaged by coupling TMS with internet-based exchange solutions (Pezeshki, Yahya, Baboli, Cheikhrouhou, Modarres and Jokar. 2013). According to Pezeshki *et al.* (2013), this would be the most suitable option for transportation networks.

2.8 Conclusion

The available literature relevant to an integrated logistics network and optimisation of logistics networks was covered. An overview of the background of the current state of modern day logistics networks was provided. It was shown that an optimisation of a logistics network may also be sought through outsourcing fourth-party logistics. An integrated logistics network was defined in terms of the two facets of internal and external logistics. Synchronisation was also discussed as an important aspect when facilitating an integrated logistics network. Lastly, an opportunity to explore technological advances was discussed.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

The research methodology of this study is presented in this chapter. Its flow scheme has been developed to ensure that various steps are followed accordingly as per the needs of the study. The reliability and validity of the data that is collected and analysed for this study are determined. This is an integral part of the study as it ensures that the integrity of the study is maintained.

3.2 Research Objectives

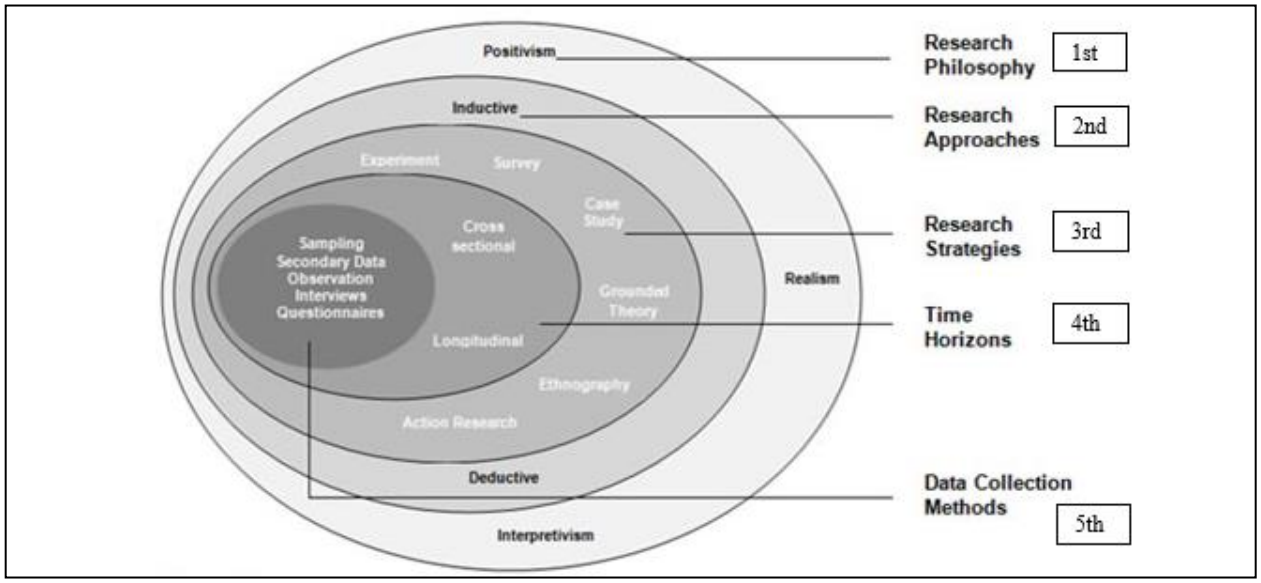
The research objectives of this study are as follows:

- To examine the effect of the process flow of the outsourced and insourced student transportation systems of the University.
- To assess the influence of an integrated logistics network to optimise the transport services of the University.
- To establish the extent of the relationship between transport scheduling and transportation facilities.
- To compare the perceived performance of selected logistical systems against the expectation of the selected stakeholders.

3.3 Research Methodology

Saunders *et al.*, (2009) present the concept of the research onion, which is a simplified representation of research. It classifies research into five stages such as research philosophy, research approaches, research strategies, time horizons and data collection methods (Saunders *et al.*, 2009).

Figure 3.1. : The Research Onion



Source: Saunders *et al.*, (2009: 138)

3.3.1 Research Philosophy

Research philosophy helps to clarify research design in terms of how research is interpreted and how it becomes useful in answering research questions (Saunders *et al.*, 2009). It also helps in understanding the overall parameters of the study. There are three main philosophical standpoints as depicted in Saunders *et al.*, (2009) research onion namely, positivism, realism, and 'interpretivism'. This study will adopt the positivist approach, which requires that a subject under analysis should be measured by objective methods rather than subjective methods. Saunders *et al.*, (2009) states, "Positivism is an epistemological position, which requires an observable social reality be worked on, and is thus objectivist ontology".

3.3.2 Research Design

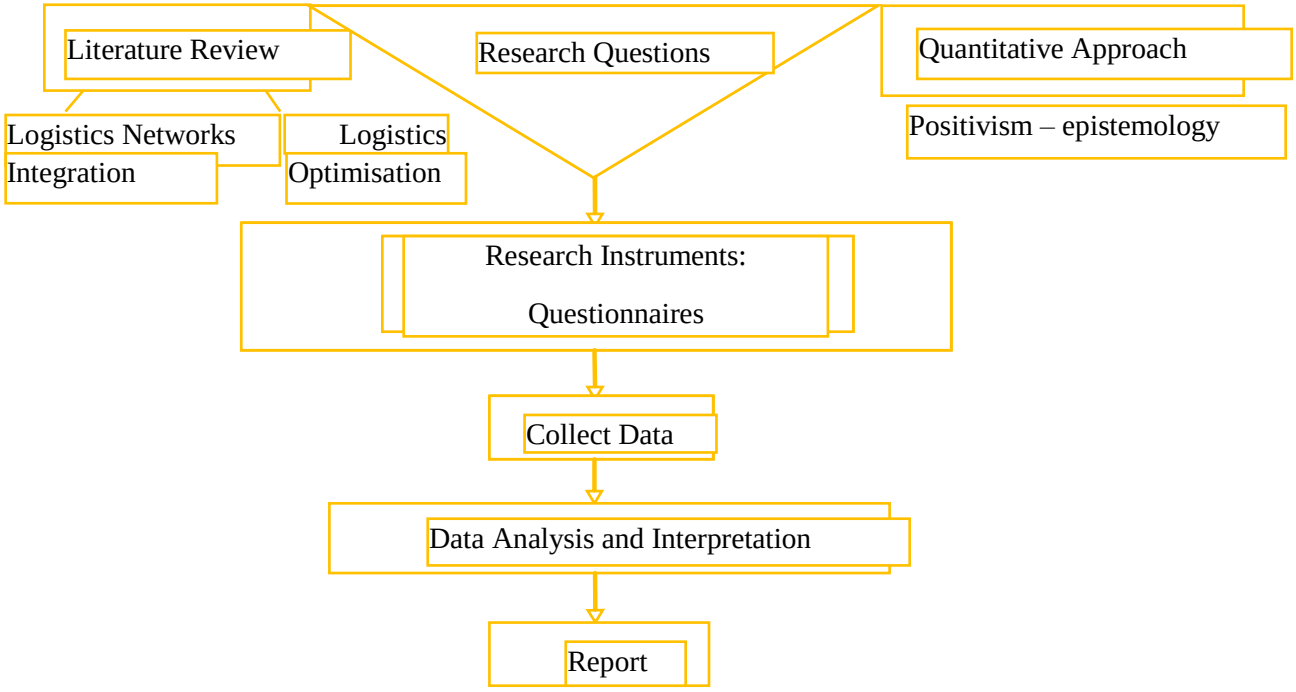
The research design adopted for this study employs an exploratory case study strategy using a cross-sectional study as data was collected at a single point in time. According to Sekaran and Bougie (2012: 122), "exploratory studies are undertaken when not much is known about the situation at hand, and no information is available on how similar research issues have been solved in the past". "In case studies, the case is the individual, the group, the organisation, the event, or the situation that the researcher is interested in" (Sekaran and Bougie, 2012).

3.3.3 Research Approach

This study applies the quantitative research approach. This approach is adopted to gain views of larger target populations to compile statistical findings (Saunders *et al.*, 2009). Data is then summarised and presented using statistical diagrams and tables (Saunders *et al.*, 2009). Data was collected and analysed using a quantitative method approach for the research problem to be understood properly (Saunders *et al.*, 2009).

The quantitative research will serve to clarify the relationships among the measured variables, developing meaning from the data that are represented through statistical analytical tools (Sekaran and Bougie, 2012).

Figure 3.2: Research Methodology Flow Scheme



Source: Designed by researcher

3.3.4 Study Site

The study was carried out in Durban, KwaZulu-Natal at the University of KwaZulu-Natal. The University of KwaZulu-Natal has off-campus residents, which are scattered within the eThekwini Municipality. The student transportation network in each campus comprises a replicated system, which is standard across all campuses in Durban.

3.3.5 Target Population

Population refers to the full target respondents from which a sample is taken (Sekaran and Bougie, 2012). The population consists of off-campus residence residing students in the University of KwaZulu-Natal in the Westville campus. The off-campus residences are said to accommodate approximately 713 students (UKZN, 2016).

3.3.6 Sample

A sample may be defined as a subset of the population (Saunders *et al*, 2009). The sample for this study consists of students residing in the (University-organised) off-campus residences in the University of KwaZulu-Natal.

3.3.7 Sampling Technique

The study was carried out at the University of KwaZulu-Natal. The sampling frame includes all the various (University-organised) off-campus residence residing students. For the quantitative study, non-probability sampling was adopted. To adequately understand students' views regarding the efficacy of the shuttle service offered by the University, one needs to employ a quantitative approach. This approach will be used to explain the relationship between the dependent and independent variables. Thus, for this purpose, this aspect of the study will adopt a convenience and purposive sampling based on proximity, the availability of respondents at the time of data collection, and ease of selection (Gill and Johnson, 2010).

3.3.8 Sample Size

The sample size must be sizable enough for the achievement of research objectives as well as for stats findings to be generated (Creswell, 2014). It could be subjected to the scarcity of financial resources and time (Creswell, 2014). The sample size of 250 respondents was determined using the Sekaran (2003) table based on a 95% confidence level and 5% margin of error. The respondents were selected based on their knowledge as well as their experiences as users of the transportation system.

3.4 Data Collection

Self-administered questionnaires were hand delivered to the appropriate respondents for collecting quantitative data. Closed-ended questions were used in the structured questionnaire to collect as much as possible relevant data. The researcher has formulated a questionnaire with four sections, these are:

- **Section A**

This comprises biographical information, including the respondents' gender, year of study, and their college. The questions in this section comprise three questions numbered 1-3. These questions required respondents to select an applicable option from provided alternatives.

- **Section B**

These questions are based on a five-point Likert scale and relate to the perceived performance and synchronisation in the University logistics supply chain. They required the participants to select the appropriate box, 1= strongly disagree, 2=disagree, 3=neutral, 4=agree and 5=strongly agree.

- **Section C**

This section contains dichotomous questions regarding the logistics network optimisation in the administration of logistics services of the University. Respondents are required to select "Yes" or "No" from options that have been provided by the researcher.

- **Section D**

This section provides an ordinal scale, which has a ranking of variables according to accordance with the respondents' understanding. The respondents were required to select three items referring to the performance of the transportation and rank them from 1 to 3 in order of importance to them. 1 indicates "least important"; 2 indicates "moderately important"; 3 indicates "most important".

3.5 Data Analysis

This study used SPSS version 22 to capture data and carry out the analysis. Data output from the statistical software was included measures of central tendency and dispersion. The data will then be displayed in the form of depictions and models to enable the analytical process (Gill and Johnson, 2010). The conclusions to be drawn from data analysis have been checked for reliability using Cronbach's Alpha and for content validity.

3.5.1 Descriptive Statistics

This section covers univariate, bivariate, and multivariate statistics.

3.5.1.1 Univariate Analysis

In descriptive statistics, including means and standard deviations, are featured where applicable. Frequencies are represented in tables or graphs. At this stage, raw data sets are transformed into information that describes aspects of a situation. The first descriptive measurement performed in this study is the mean, which measures central tendency, which in turn provides a general picture of the data. The mean value enables for overview interpretation of the data without overwhelming the interpreter with more details. The researcher also made an analysis of the median, the central observation of a group, which has been sorted in descending and ascending order. Furthermore, the researcher analysed the variability in the data sets by the means of the standard deviation, and thereafter the variance was calculated.

3.5.2 Inferential Statistics

Correlational relationships of the independent and dependent variables are discussed in the quest of addressing research objectives and questions.

3.5.2.1 Bivariate Analysis

Two approaches were used to evaluate the extent of relationships between variables; these are bivariate and multivariate. Creswell (2014) describes bivariate data analysis as a measurement of two variables having a correlational relationship. The use of tables is provisional whereby a variable is related to values of another. The Pearson correlation coefficient shall be measured to determine the extent of the relation between the dependent variable; (transportation schedule) and independent variables; (transportation facilities, transport communication, transportation timeliness, transport fluctuation, disabled commuters, and sporting arrangement). Correlation will help in determining whether a variable must be part of multiple regression analysis. The researcher aimed to depict relationships and interrelation between two variables. The researcher, therefore, measured the correlation between the variables observed in this study.

3.5.2.1.1 Cross Tabulation

The researcher has formulated tables for statistical examination in this section through a method called “cross tabulation”. This can be defined as a technique that compares categorical data in the target variables of a study and the demographic variables (Creswell, 2014). There are contingency tables that were constructed for statistical analysis. As a bivariate analytical tool, cross-tabulation is used in establishing relationships between two variables. As such, the information that could be

presented in this format has a two-dimension frequency distribution with the variables being cross-tabulated. In cases whereby, the variables have different values, they could not be cross-tabulated meaningfully, summary statistics aided in describing the extent to which there is an association amongst variables.

3.5.2.1.2 Correlation

According to Pallant (2011: 128), correlation of analysis describes the strength and linear association direction amongst two variables. In this study, the correlation relationship was analysed using Pearson product-moment correlation coefficient r. This coefficient is mainly designed to be used for interval/continuous level data. The r coefficient can only lie between the values of -1 to +1. The signs indicate whether there exists a negative or positive correlation amongst two variables. However, a zero coefficient indicates that there is no relationship or association between two variables

3.5.2.2 Multivariate Analysis

This statistical technique is used in analysing data that do not only arise from a single variable. In this study, multivariate analysis is considered in terms of multiple regression as well as factor analysis. Multiple regression and factor analysis are both corresponding methods, which seek to obtain summary statistics. Multivariate data analysis is used when looking at relationships between sets of variables whereby the reason is to anticipate the variable with a probable effect on another (Creswell, 2014). During this stage, variables will be sorted in a classification between independent and dependent. Dependent variables are ones that are being measured in a study; they are influenced by independent variables (Creswell, 2014). Independent variables, on the other hand, can never be influenced, manipulated, and or controlled (Creswell, 2014). For this study, both methods; multiple regression and factor analysis are used in data analysis.

3.5.2.2.1 Multiple Regression

Multiple regression is utilised to “illustrate dependency by showing the extent to which the independent variables influence the dependent variable” (Lehman, O’Rourke, Hatcher, and Stepanski, 2013). This expands from the bivariate analysis which is only limited to two variables, multiple regression looks at three or more. There are three types of instances whereby multiple regression can be used (Brace, Kemp, and Snelgar, 2012). One instance is whereby it is utilised to formulate an equation for the prediction of the values of the dependent variables utilising the values of the independent. Another instance is to control cumulative variables to deliver an improved

analysis of contributions that are made by other variables in the study. Lastly, casual theories can also be tested and explained using multiple regression.

Brace *et al.,* (2012) state that collinearity can be found whereby two independent variables are observed to be vastly correlated thereby having a negative effect on a model being used. Multi-collinearity refers "to the correlation that is between three or more independent variables as well as its negative impacts on a model that is being used" (Lehman *et al.,* 2013). The existence of multicollinearity makes the interpretation of coefficients difficult as it can dramatically fluctuate the value of the estimated regression coefficient. Through the usage of variance inflation factor (VIF) values the researcher can determine the existence of multicollinearity in the model.

An indication of the degree to which extent the independent variable is not influenced by other independent variables is known as tolerance (Brace *et al.,* 2012). If it is below 0.10 then tolerance shows multiple correlations between variables, showing a possible multicollinearity. The variance inflation factor, on the other hand, is the numerical opposite of tolerance; if it is more than 10 then this shows multicollinearity (Lehman *et al.,* 2013). The normality and linearity plot of regression assures that mutual variances are not violated (Brace *et al.,* 2012). A validity that represents "assumptions about the residual values of a normal P-P plot follows a normal dispersion" (Lehman *et al.,* 2013). The points on the straight-line points are the expected values from the data and it matches the diagonal line hence suggesting that there are no deviations from normality. Normality can be found whereby none of the assumptions of ordinary least squares is violated (Brace *et al.,* 2012). The first assumption is that the parameters of the model are clearly specified and it is linear; secondly, the term is uncorrelated with the independent variables; and thirdly, there is homoscedasticity in the constant; lastly, the model is free from autocorrelation. Alongside multiple regression analysis and tests, factor analysis was also used in this study.

3.5.2.2.2 Factor Analysis

Pallant (2011:186) describes factor analysis as "an analysis that tries to discover a small set of factors that represents the actual association among groups of variables that are related". It is a form of reducing model. It does this by taking a large set of variables and then reduces them to a smaller set. For this research study, the exploratory type of factor analysis was employed. The reason is that exploratory factor analysis process is "utilised in the early stage of a study to pull up information or explore the interrelationship between some variable sets" (Statsoft, 2012: 1). This research study employed the method known as principal component analysis (PCA).

3.6 Reliability and Validity

The method of measuring reliability used in this study is the Cronbach's Alpha. This method used a coefficient, which provides an estimate of internal consistency of the scores that can be derived on a scale or composite score (Vanderstoep and Johnston 2009). The Cronbach's Alpha coefficient helps in ascertaining if the interpretation of accumulated scores can be justified. Reliability is of high importance due to validity being difficult to gain in the absence of reliability. According to Vanderstoep and Johnston (2009: 63), a scale's internal consistency includes the magnitude to which the whole items or components that make up the complete scale interact together. It tests whether those items measure the same construct that it is meant to. The internal consistency of scales is called Cronbach's alpha coefficient and should be above 0.7. The reliability of any scale can alter but this relies on the sample data.

3.7 Independent-samples T-Test

An independent samples t-test is used when one wishes to like the mean score on a continuous variable, with two unlikely groups of respondents or instances. This type of test tells one whether a statistically significant mean score difference exists between two groups. Statistically, it means that a researcher is testing the chance that a set of scores is from the same population (Vanderstoep and Johnston 2009: 123).

3.8 Ethical Considerations

This study was designed in a form that conforms to ethical standards and guides that have been made available through the University Research Ethical Policy. Permission was obtained from the University of KwaZulu-Natal to carry out the research. Consent from all data sources was also sourced prior to any interactions of data collection. The researcher sought approval from all participants of the study.

3.9 Conclusion

The research methodology of a study is very important, and therefore the applicability of the selected is paramount. A self-administered questionnaire was used as a method of compiling primary data. The quantitative data analysed in this study were analysed using the SPSS software programme. The interpretation of results was done through multiple formats ranging from Univariate, Bivariate and Multivariate analysis. The subsequent chapter will unpack in detail all data analysis of the primary data obtained from the sample.

CHAPTER FOUR

DATA ANALYSIS AND PRESENTATION

4.1 Introduction

This chapter explains the analysis from the data collected in the research study. Generally, the univariate, bivariate and multivariate statistics were carried out to extricate the needed answers to the study questions and objectives.

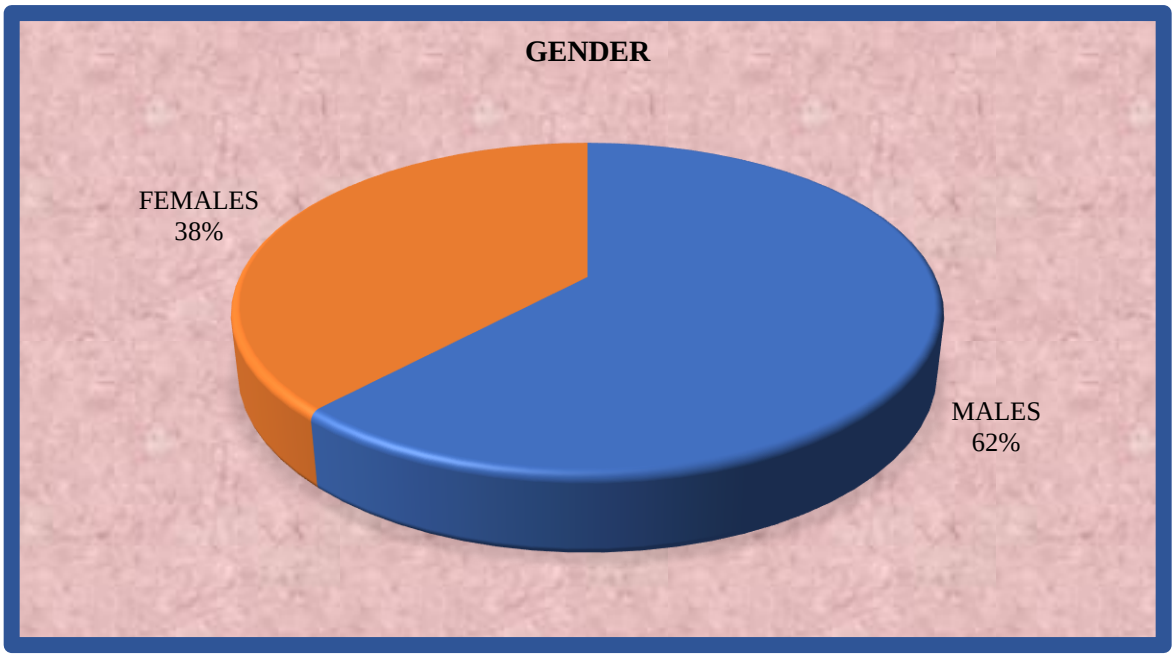
4.2 Univariate Analysis

Frequencies are presented in diagrammatic formats, means and standard deviations are also discussed.

4.2.1 Frequency Distribution of Data

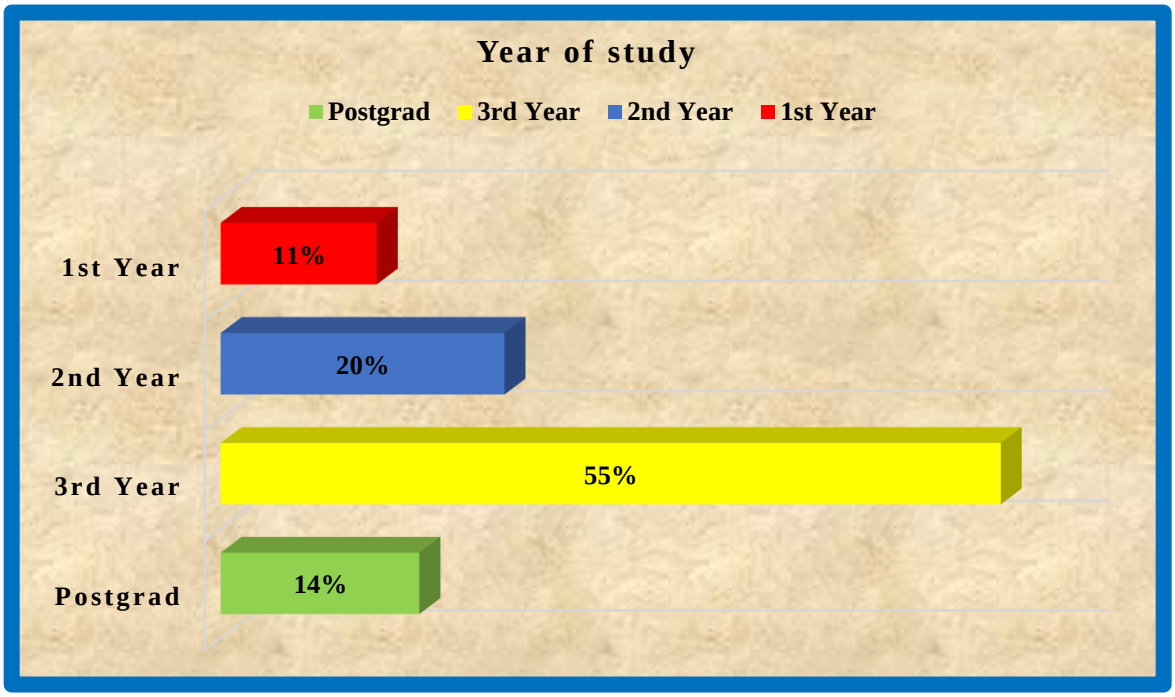
Frequency distribution graphs are plotted and concise explanations of the data that are represented in the instrument are explained (Questionnaire).

Figure 4.1: Gender



This report shows that thirty-eight per cent (38%) of the respondents are females and sixty-two per cent (62%) are males. More of the male participants agreed to participate in this study than their female counterparts. It can also be that more of the male respondents live off-campus than the females. The researcher conducted the study by visiting off-campuses residences, male students are fonder of staying indoors in their dome rooms than their female counterparts.

Figure 4.2: Year of study



In Figure 4.2 above, fifty-five percent (55%) of the total respondents to this research study are in their 3rd year of study at the University of KwaZulu-Natal, twenty percent (20%) are in their 2nd year of study, fourteen percent (14%) are postgraduates, while the least represented respondents are in their 1st year with eleven percent (11%) response rate. What the researcher notes from the figure above, is that most respondents are in their third (3rd) year of study and will soon be graduating from the University and prefer to live off campus.

Figure 4.3: College

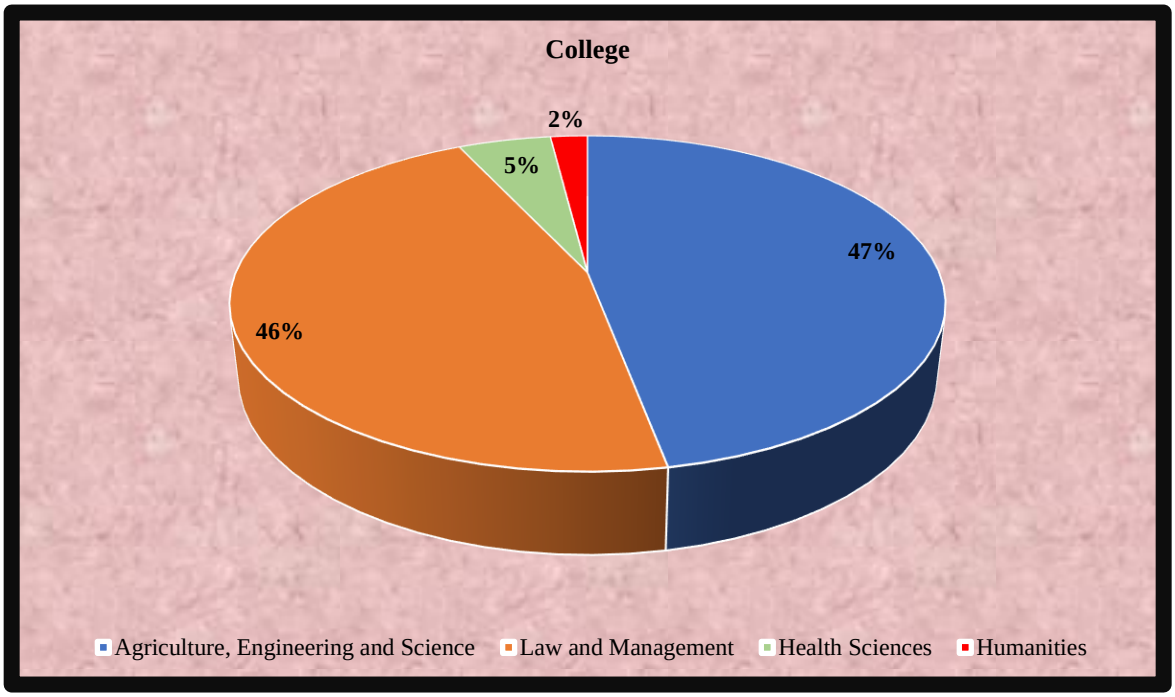


Figure 4.3 above depicts the percentage of respondents in their varied colleges. The highest represented college is Agriculture, Engineering and Science with forty-seven per cent (47%) response rate. The College of Law and Management Studies with forty-six per cent (46%) response rate follows this. Five per cent (5%) of the respondents are from College of Health Sciences while two per cent (2%) of the respondents are from Humanities College of the University of KwaZulu-Natal, Durban, South Africa.

Figure 4.4: Transportation schedule

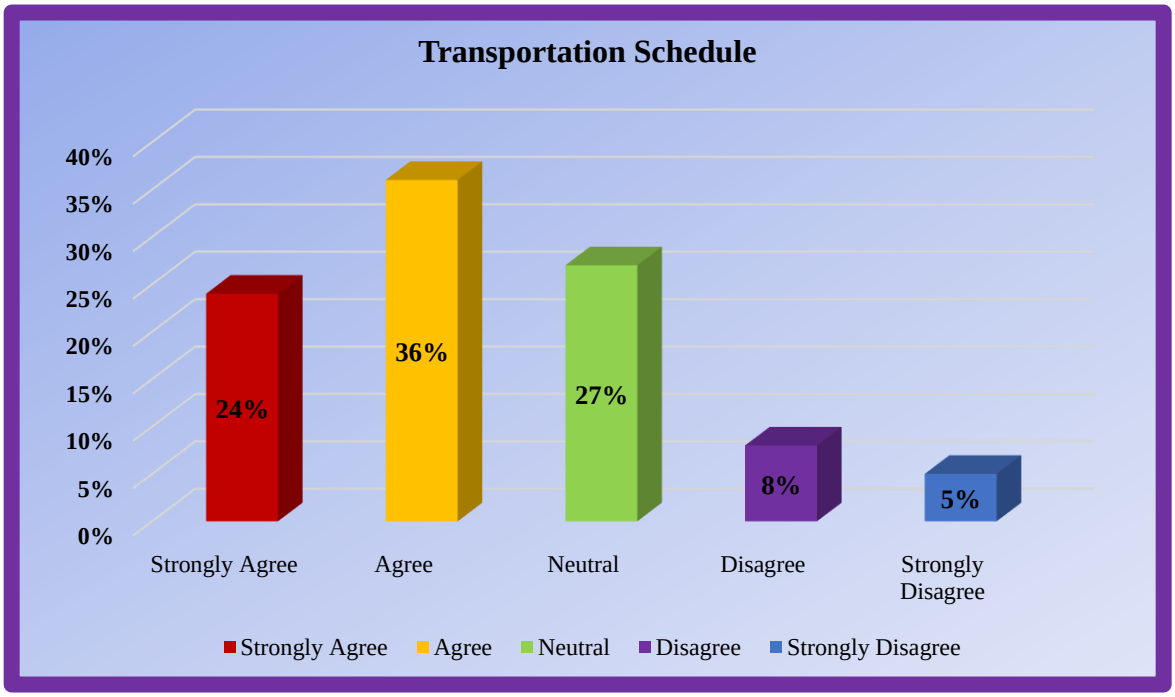
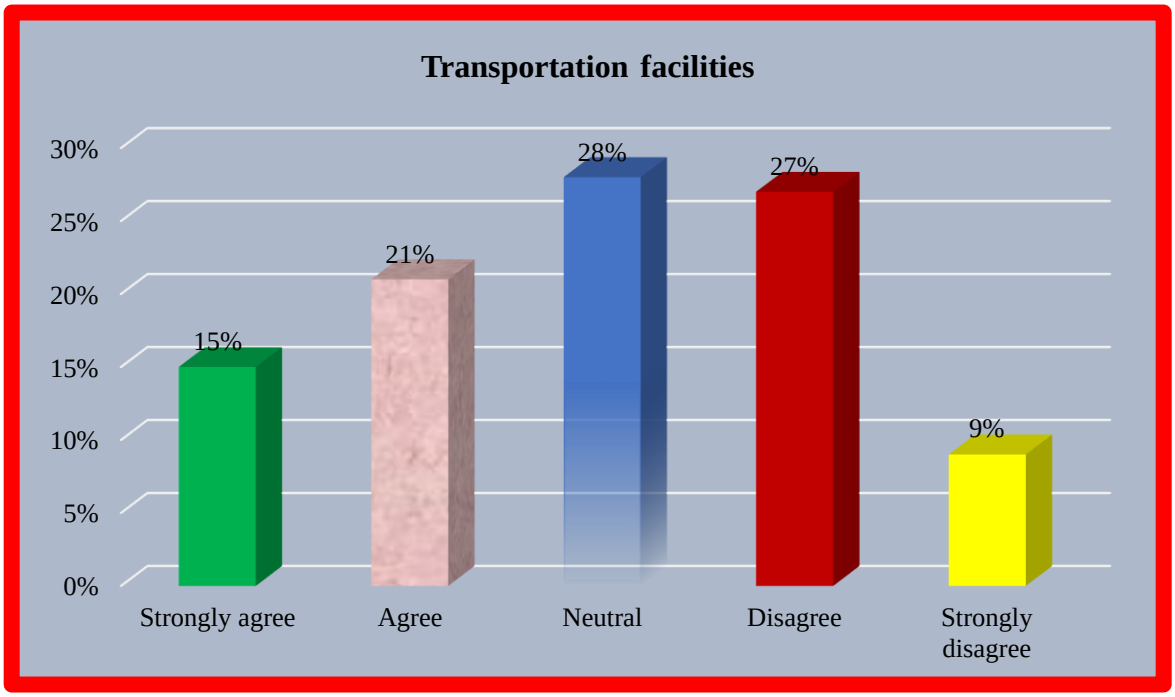


Figure 4.4 above describes the transportation schedule provided by the University to students. Thirty-six per cent (36%) of the respondents agreed the schedule of transportation provided for their school by the University is suitable and corresponds with their timetable. Twenty-four per cent (24%) of the respondents strongly agreed to this statement, twenty-seven per cent (27%) gave a neutral response while eight per cent (8%) disagreed that the University transportation schedule meets their needs. Just five per cent (5%) of the respondents strongly disagreed that the transport schedule provided by the University for them corresponds to their school timetable. Most respondents agreed that the transportation schedule meets the requirements of their school timetable needs.

Figure 4.5: Transportation facilities



In Figure 4.5, twenty-eight per cent (28%) of the respondents gave a neutral response to the statement that the University provides enough transport facilities to suit their residence needs. Twenty-seven per cent (27%) of the respondents disagreed with the statement. Twenty-one per cent (21%) of the total respondents agreed that the University provides enough transport facilities that meet their residential needs. Fifteen per cent (15%) of the respondents strongly supported the statement while only nine per cent (9%) disagreed strongly. The high rate of negative responses may be related to the time schedule offered by the transport units, which may not be flexible for the students. There is an equal amount of people who disagreed and agreed. There is a polarised response from respondents.

Figure 4.6: Transportation fluctuations

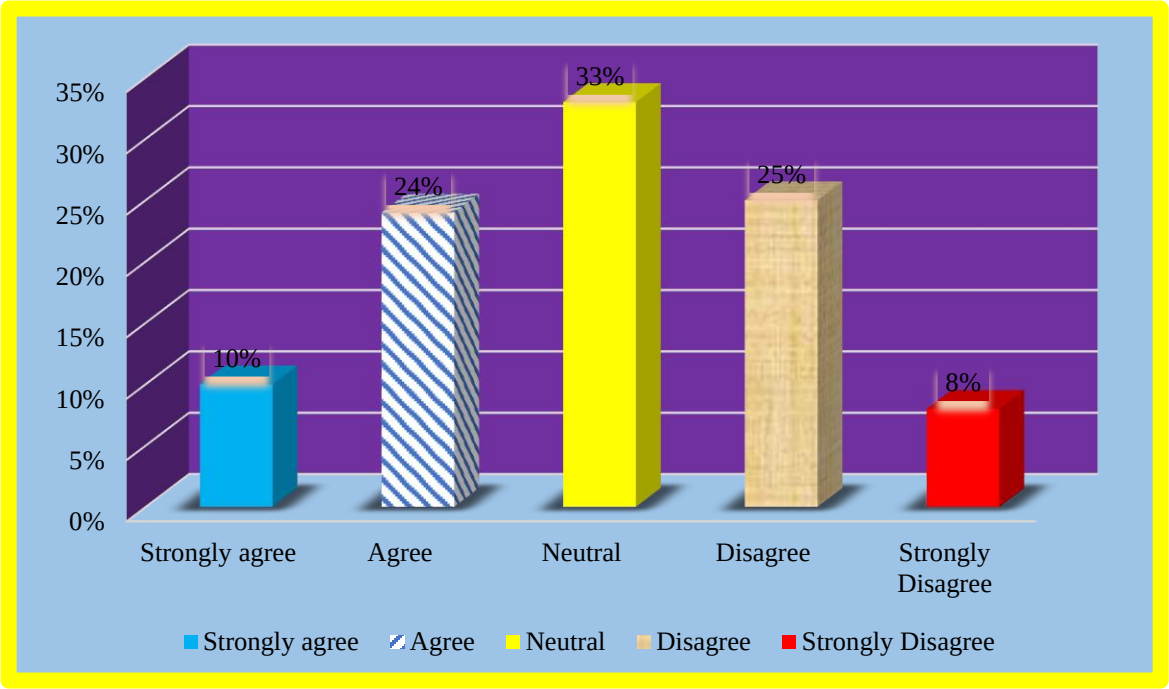
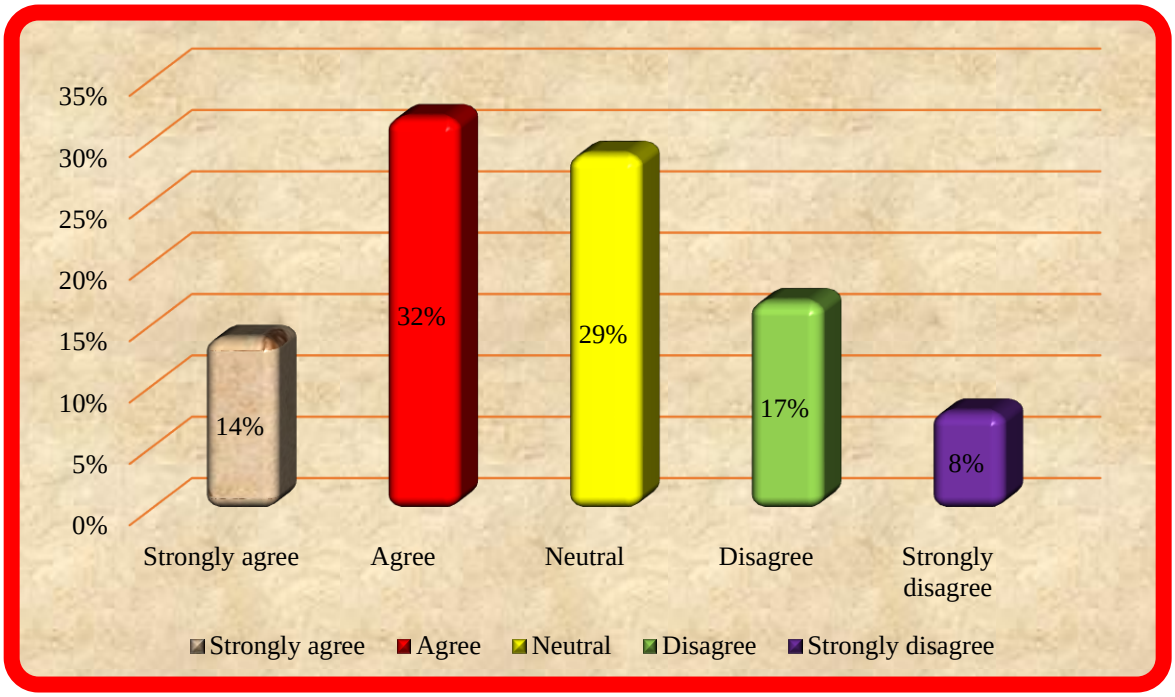


Figure 4.6 above illustrates responses from the study participants in relation to transport fluctuations at the University of KwaZulu-Natal. A high rate of thirty-three per cent (33%) response is recorded against participants who were neutral that the transport schedule provided by the University caters for any fluctuations and students' need. Twenty-five per cent (25%) of the respondents disagreed with the statement that "transportation schedules cater for any fluctuations according to students' needs" while twenty-four per cent (24%) of the respondents agreed. A ten per cent (10%) rate of response is seen, from respondents that strongly agreed that the transport schedule is flexible and hence caters for any hitches or disruptions to suit the student needs. Lastly, eight per cent (8%) of the respondents strongly disagreed that the transport schedule caters to any fluctuations according to student needs. The ratio of people who agree and those who disagree is slightly polarised.

Figure 4.7: Transport timeliness



In Figure 4.7, a high response rate of thirty-two per cent (32%) is recorded from the respondents that agreed with the statement that the transportation provided by the University, works in a timely manner. Twenty-nine per cent (29%) of the respondents were neutral to this statement and seventeen per cent (17%) of the respondents disagreed totally, that the transportation provided works in a timely manner. However, a fourteen per cent (14%) rate of response is seen from respondents who strongly agreed that the provided campus transport works in a timely manner. Only eight per cent (8%) of the respondents strongly disagreed that the transport provided works in a timely manner. The number of people who agree far exceeded those who disagreed, there is a high level of satisfaction regarding the timely operation of the network.

Figure 4.8: Transport communication

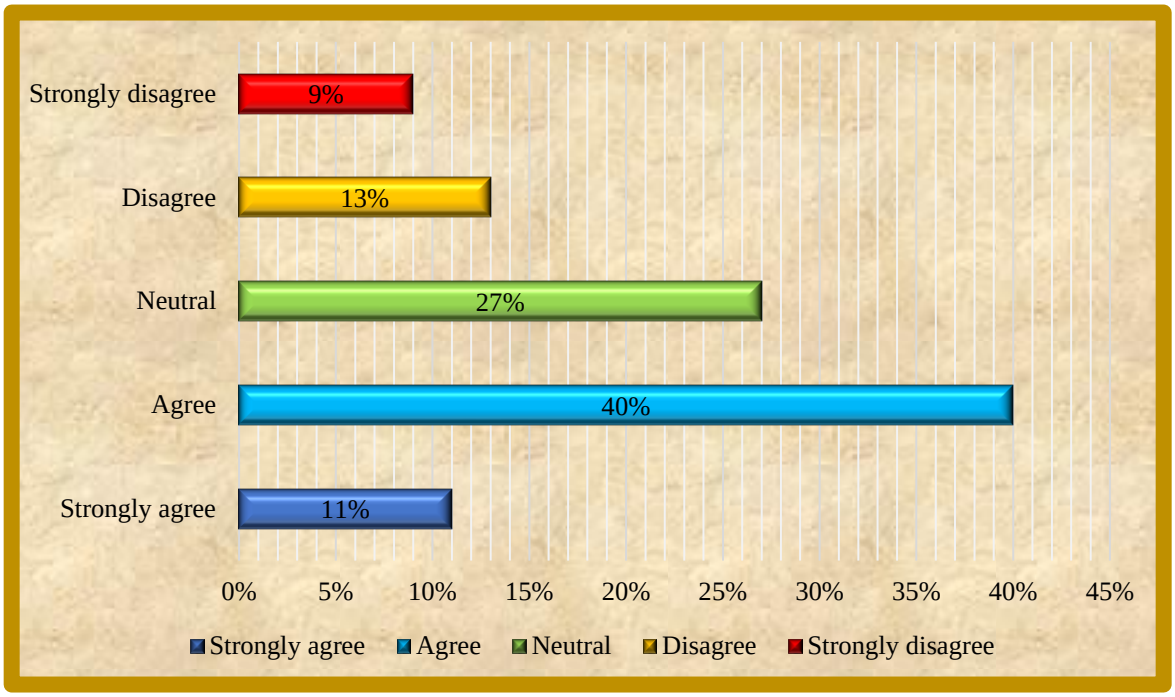
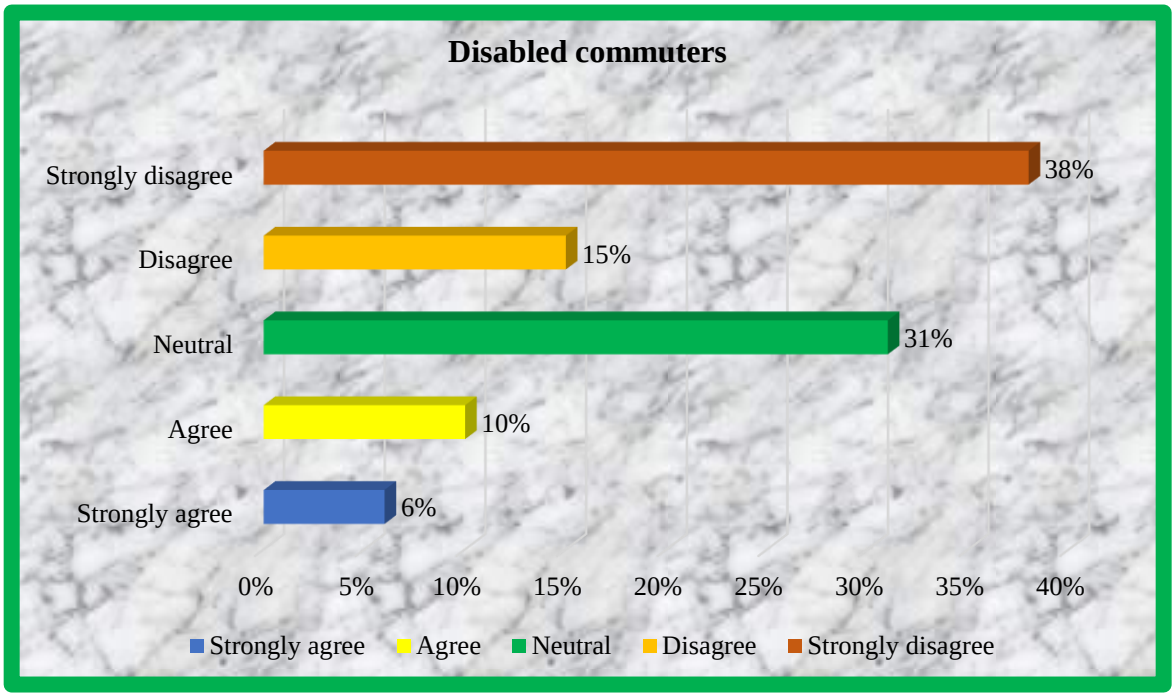


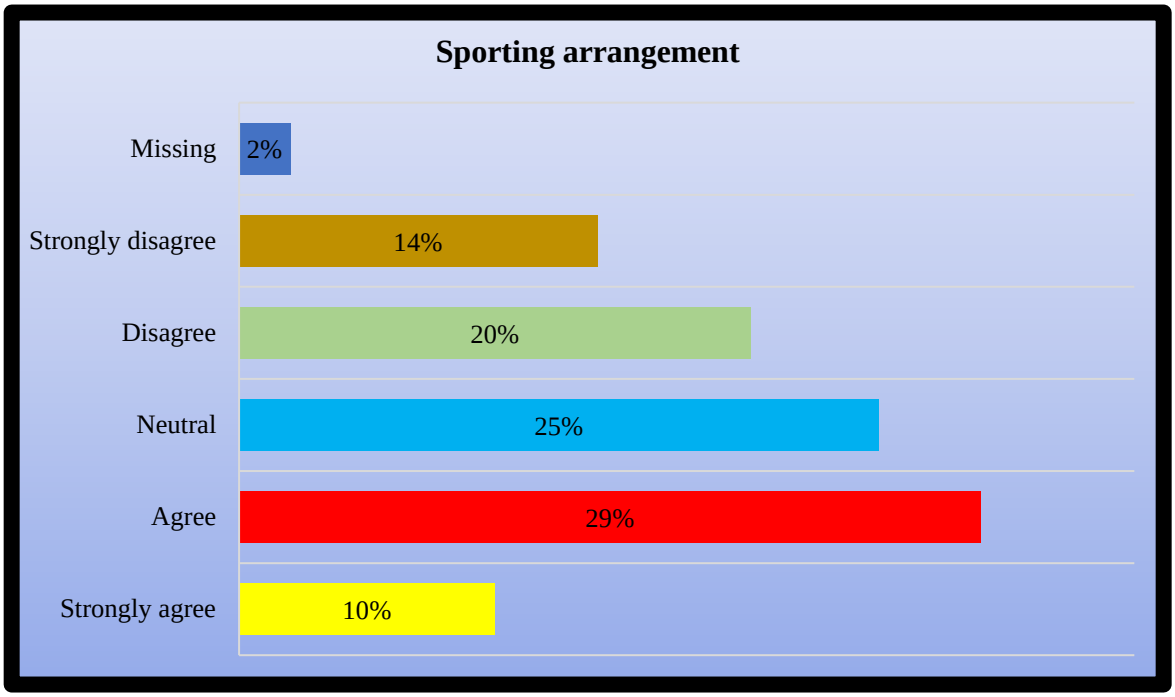
Figure 4.8 illustrates the data for transport communication. Forty per cent (40%) response rate is recorded against the participants who agreed that transportation arrangements are communicated in a suitable manner. Twenty-seven per cent (27%) of the respondents were neutral to the statement that transport arrangements are communicated in a suitable manner. About thirteen (13%) of the respondents disagreed that a suitable communication about transport arrangement was given and eleven (11%) of the respondents agreed strongly that arrangements about the transports are communicated timely to them. Only a nine per cent (9%) rate of response is observed and relates to respondents who strongly disagreed that transport arrangements are communicated timely to them.

Figure 4.9: Disabled commuters



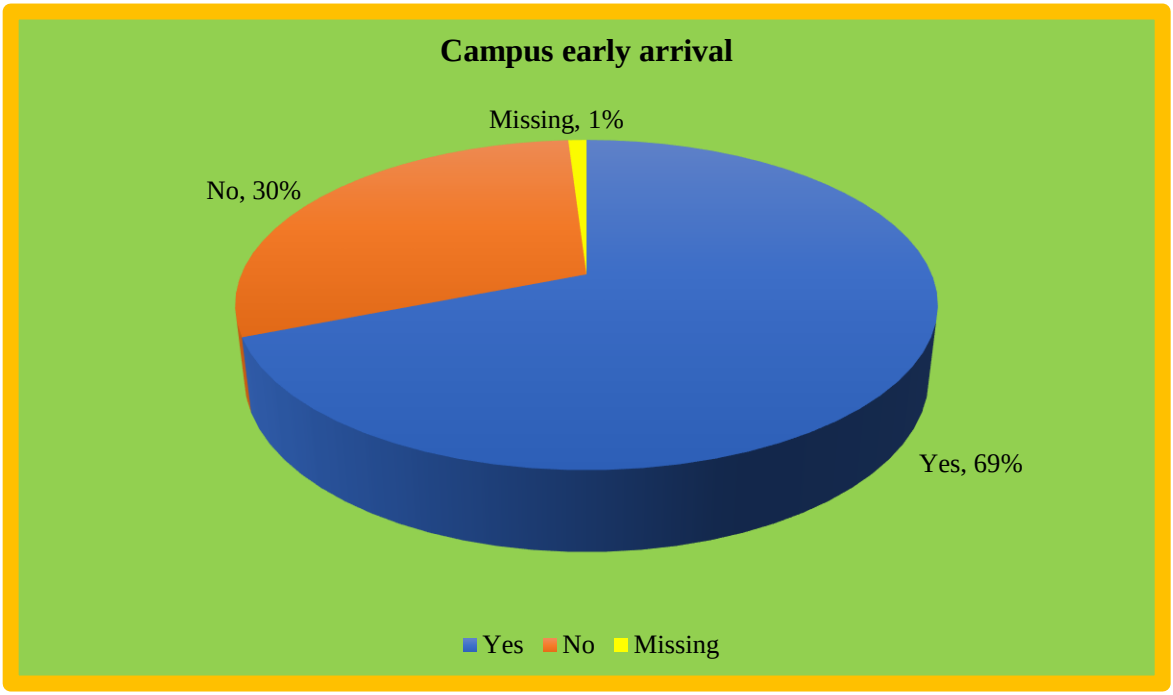
A huge number of respondents of thirty-eight per cent (38%) rate strongly disagreed that the transport facility provided by the University caters for disabled commuters, as can be seen in Figure 4.9 above. This notion shows that the transportation avenue provided is not user-friendly to the disabled commuters. Thirty-one per cent (31%) of the respondents remained neutral to the statement concerning the transport facility provided by the University and how it caters for the disabled commuters. Fifteen per cent (15%) of the respondents disagreed that the transport facility provided by the University caters for the disabled commuters. However, ten per cent (10%) of the respondents agreed that the disabled commuters are catered for in terms of transport provided. Lastly, six per cent (6%) of the respondents strongly agreed that the disabled commuters are catered for in relation to transport provided.

Figure 4.10: Sporting arrangements



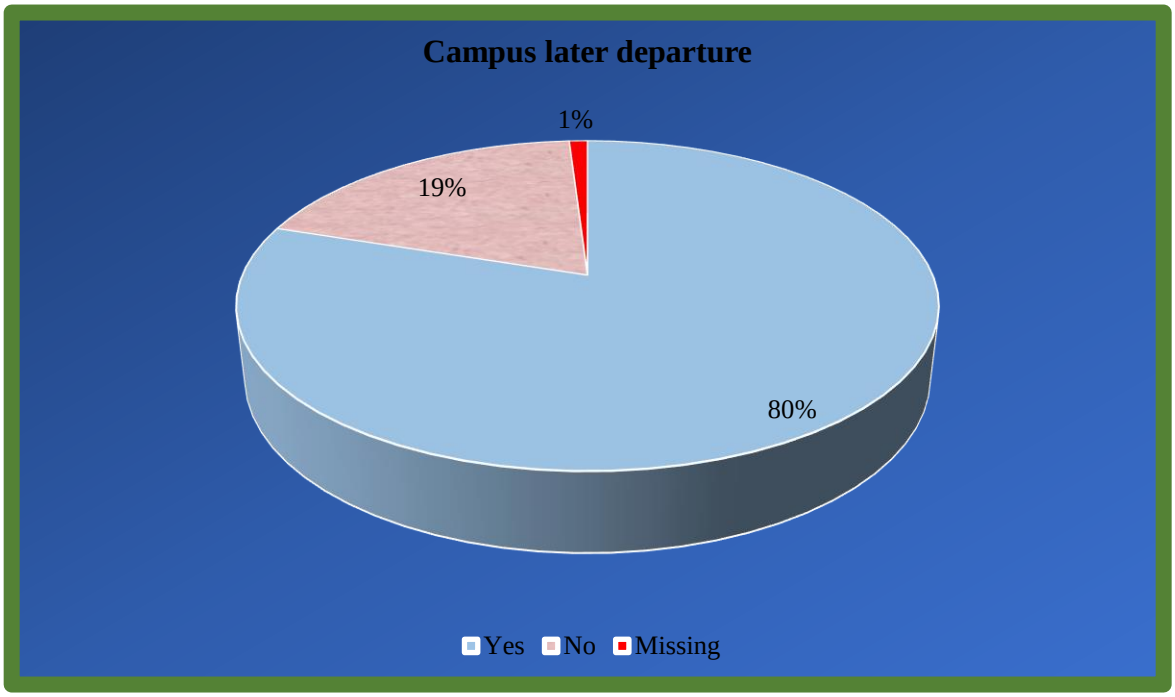
From Figure 4.10 above, twenty-nine per cent (29%) of the respondents agreed that transport provision is adequately made for sporting activities and other special events. Twenty-five per cent (25%) of the respondents remained neutral about the statement on transport facilities provide for sports and special events. A twenty per cent (20%) rate of response can be seen from the figure above, these are respondents who disagreed concerning transport facility being made available for sports and special events. Nevertheless, fourteen per cent (14%) of the respondents disagreed strongly that transport facilities are made available during sporting and special events. Also, ten per cent (10%) of the respondents strongly agreed that transportation is provided during sporting and special events. Finally, two per cent (2%) of the respondents omitted this question and cannot be accounted for, with respect to this question.

Figure 4.11: Campus early arrival



Concerning the logistics network optimisation, respondents were asked varied questions. From Figure 4.11, sixty-nine per cent (69%) of the respondents agreed that they would arrive on campus earlier, thirty per cent (30%) disagreed and only one per cent (1%) of the respondents are missing. From the researcher's perspective, arriving on campus earlier allows the respondents to settle down well and carve out his/her daily activities better.

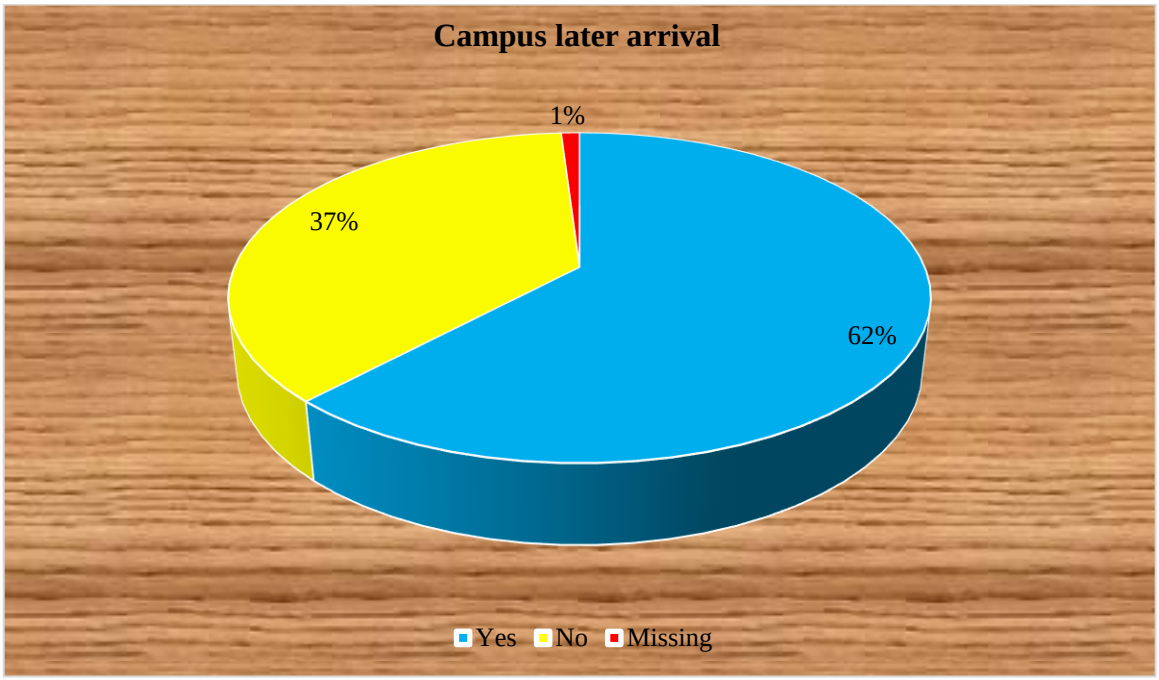
Figure 4.12: Campus later departure



Respondents were asked whether they would depart from campus later than usual. Eighty per cent (80%) of the respondents agreed that they would prefer to leave campus later than the estimated time of the schedule. Nineteen per cent (19%) said “No”, this means that they would not prefer to leave campus at the estimated time of the schedule. Lastly, one per cent (1%) of the respondents did not answer this question at all.

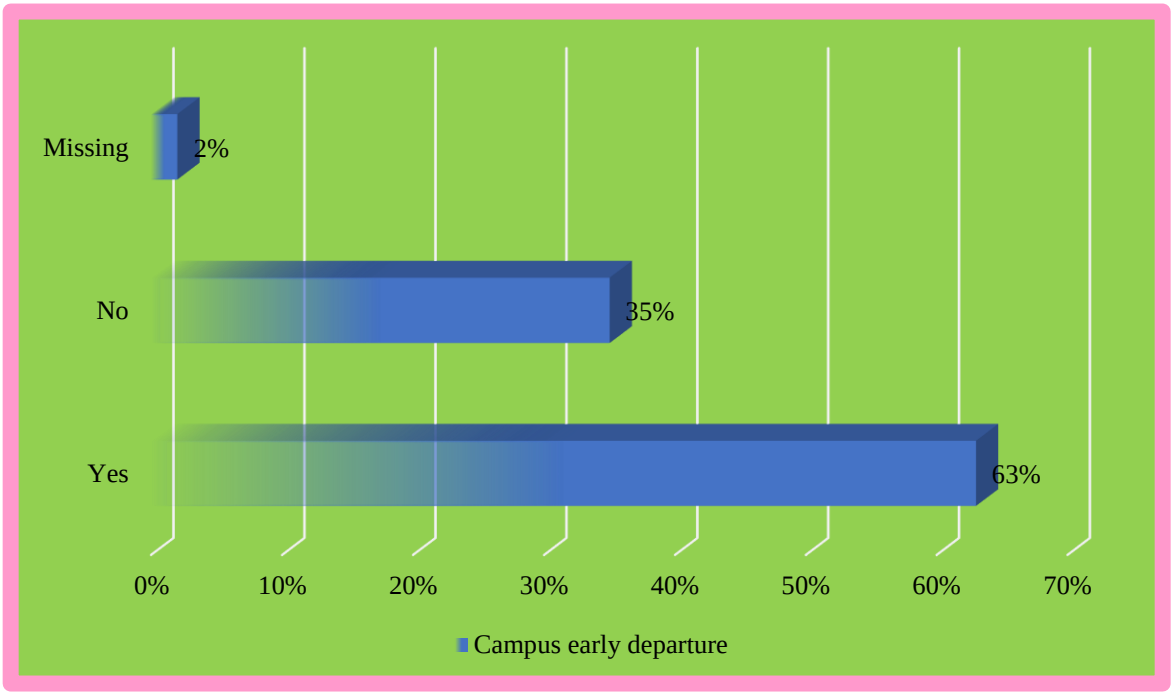
The researcher believes most respondents prefer leaving campus late to avoid procrastination in their work. Respondents will likely prefer to complete their assignments and read through their classwork before heading home.

Figure 4.13: Campus later arrival



From Figure 4.13 above, sixty-two per cent (62%) of the respondents agreed that they would want to arrive on campus later. A thirty-seven per cent (37%) response rate is recorded against participants that disagreed that to the statement that they would want to arrive on campus later. Finally, one per cent (1%) response rate is noted as 'missing'.

Figure 4.14: Campus early departure



In discussing Figure 4.14, it shows that sixty-three per cent (63%) of the respondents supported the statement that they prefer to depart from campus earlier. Thirty-five per cent (35%) of the respondents disagreed and prefer to depart from campus later. However, two per cent (2%) of the respondents did not give an answer to the question at all.

Figure 4.15 Flexible transport schedule

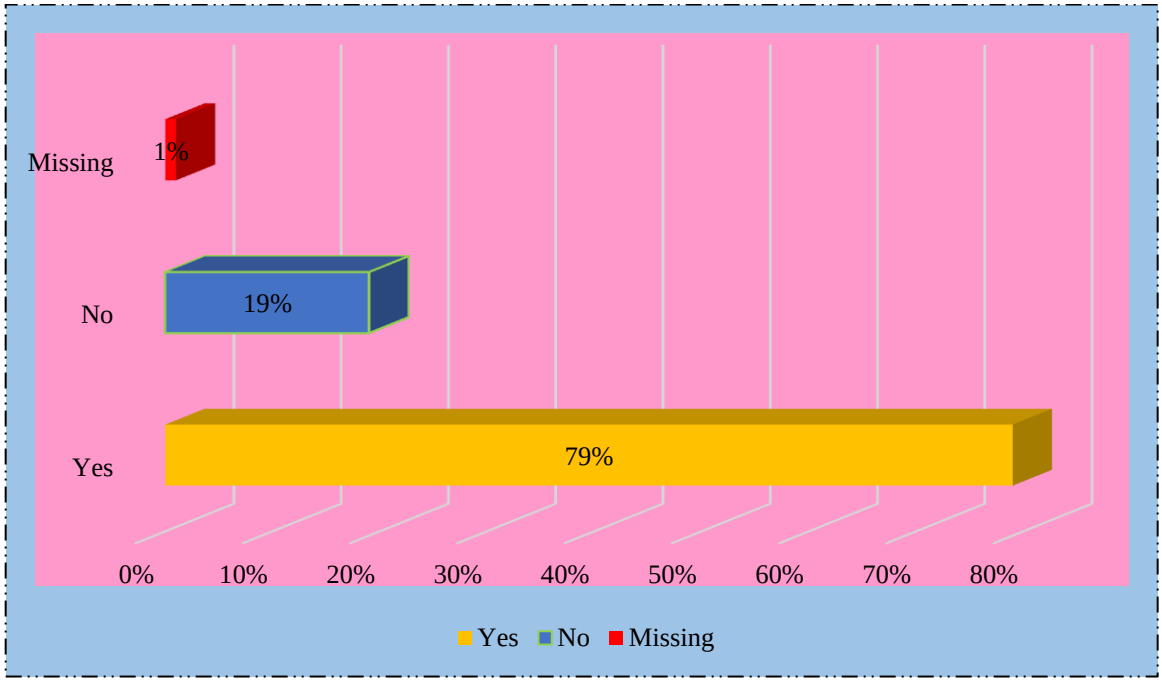
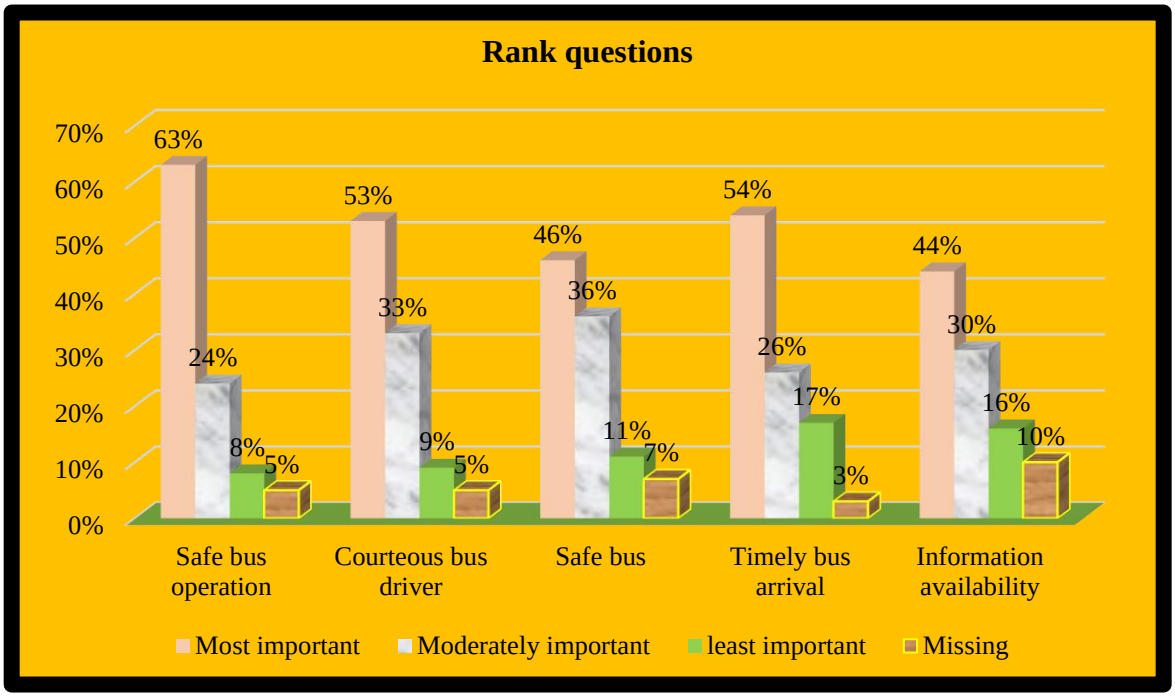


Figure 4.15, illustrates the flexible schedule of transport. A high rate of seventy-nine per cent (79%) of respondents said 'YES' that they would prefer a more flexible transport schedule if they wish. Only nineteen per cent (19%) of the respondents disagreed with this. However, one per cent (1%) response from the participants did not answer this question.

Figure 4.16: Ranking questions in order of importance



From Figure 4.16 above, the respondents were asked to rank different questions in their order of importance. For the variable (safe bus operations), sixty-three per cent (63%) of the respondents said that this variable was most important to them, twenty-four per cent (24%) of the respondents said that it was moderately important to them. Three per cent (3%) of the respondents said that a safe bus operations variable is least important to them. Only five per cent (5%) of the respondents did not give information at all for this variable. For the variable (courteous bus driver), fifty-three per cent (53%) of the respondents said that the bus driver is courteous and professional and that this variable is the most important to them. Thirty-three per cent (33%) of the respondents also concurred that the driver is courteous and professional but that this variable is moderately important to them. Only nine per cent (9%) of the respondent said that the bus driver is courteous and professional, but they also believed that this variable is least important to them. Five per cent (5%) of the respondents did not give information concerning this variable at all.

For the variable (safe bus), forty-six per cent (46%) of the respondents believed that this variable is the most important to them, which means that the bus is clean and the condition of the bus is safe. Thirty-six per cent (36%) of the respondents believe that the bus is clean and that the bus condition is safe, but that this variable is moderately important to them.

Eleven per cent (11%) of the respondents believe that this variable (safe bus) is least important to them and only seven per cent (7%) of the respondents did not give information concerning this variable at all. For the variable (timely bus arrival), fifty-four per cent (54%) of the respondents said that buses arrive on time and that this variable was most important to them. Twenty-six per cent (26%) of the respondents said that the buses arrive on time and it was moderately important to them. Seventeen per cent (17%) of the respondents said that buses arrive on time, but is least important to them. Lastly, only three per cent (3%) of the respondents did not give information for this variable.

For the variable (information availability), forty-four per cent (44%) of the respondents said that information about the buses is available and that this variable was most important to them. Thirty per cent (30%) of the respondents said that the information about the buses is always available and that this variable was moderately important to them. Sixteen per cent (16%) of the respondents said that there is information available about the buses but that this variable is least important to them. Finally, only ten per cent (10%) of the respondents did not give information for this variable.

In conclusion, viewing the graph in the figure above, it can be deduced that the three items that are ranked in the order of importance include:

- The operation of the bus is safe (Most important)
- Buses arrive on time (Moderately important)
- Availability of the information about the buses (Least important)

4.3 Bivariate Analysis

This section covers cross tabulation as well as correlation analysis.

4.3.1 Cross Tabulation

The cross-tabulation table may be a two-dimensional table. It can explain the frequency to which the study participants' responses are related. This study employs the cross-tabulation table to assess the relationship between some nominal and categorical variables. The study uses a 95% significance level.

Table 4.1: Binomial test on logistics network optimisation in the logistics services of the University

Binomial Test						
		Category	N	Observed Prop.	Test Prop.	Exact Sig. (2-tailed)
Campus Early Arrival	Group 1	Yes	139	.70	.50	.000
	Group 2	No	61	.31		
	Total		200	1.00		
Campus Later Departure	Group 1	Yes	161	.81	.50	.000
	Group 2	No	38	.19		
	Total		199	1.00		
Campus Later Arrival	Group 1	Yes	125	.63	.50	.000
	Group 2	No	74	.37		
	Total		199	1.00		
Campus Early Departure	Group 1	Yes	127	.64	.50	.000
	Group 2	No	70	.36		
	Total		197	1.00		

From Table 4.1, there is a statistically significant 'YES' reaction to the statement that 'the student would arrive earlier on campus' ($p < 0.05$); this assumes that the students really want to be on campus in good time. This result supports the descriptive analysis in Figure 4.11. There is a statistically significant 'YES' response that 'if students could, they would depart from campus later' ($p < 0.05$); this infers that maybe most students prefer to stay back on campus to rehearse their schoolwork rather than going home. There is a statistically significant 'YES' response that 'if students' could, they would arrive on campus later' ($p < 0.05$); this indicates that some of the respondents prefer to arrive on campus later. This may be due to individual freedom to choose and decide on ideas. There is a

statistically significant 'YES' response that 'if the respondents could, they could depart from campus earlier' ($p < 0.05$). Some of the students may have other engagement after school that is why they prefer to leave campus on time. All these statistical binomial test results support the descriptive previously analysed in this study.

4.3.2 Correlation

Objective One: To examine the effect of the process flow of the outsourced and insourced student transportation systems of the University.

According to Pallant (2011:128), correlation of analysis describes the strength and linear association direction amongst two variables. In this study, a correlation relationship will be analysed using Pearson product-moment correlation coefficient *r*. This coefficient is mainly designed to be used for interval/continuous level data. The r coefficient can only lie between the values of -1 to +1. The sign indicates whether there exists a negative or positive correlation amongst two variables. However, a zero coefficient indicates that there is no relationship or association between two variables. Burns and Grove (2001:256) defined correlation as the relation between two or more variables. The use of correlation in the study was to examine the relationship between the dependent variable namely short-term scheduling and independent variables comprised of order quantity, on-time delivery, workforce, innovative technology, information dissemination, bottleneck, cycle time and performance targets. For correlation, the null hypothesis is that r = 0 -- that there is no relationship between the variables.

Table 4.2: Transport schedule relates to transport fluctuations

Correlations			
		Transportation Fluctuations	Transportation Schedule
Transportation Fluctuations	Pearson Correlation	1	.483**
	Sig. (2-tailed)		.000
	N	201	201
Transportation Schedule	Pearson Correlation	.483**	1
	Sig. (2-tailed)	.000	
	N	201	201
**. Correlation is significant at the 0.01 level (2-tailed).			

$H_0$1: There is no relationship between transportation schedule and transportation fluctuations.

H_a1: There is a relationship between transportation schedule and transportation fluctuations.

Using Pearson product moment correlation coefficient, there is positive correlation between the transport schedule and transport fluctuations, $r = .48$, $n = 201$, $p < 0.01$. Fluctuations from normal lecture times, tests and examinations. The researcher rejects the null hypothesis which states that there is no relationship between the transportation schedule and transport fluctuations.

Table 4.3: Transportation schedule relates to transportation facilities

Correlations			
		Transportation Schedule	Transportation Facilities
Transportation Schedule	Pearson Correlation	1	.567**
	Sig. (2-tailed)		.000
	N	201	201
Transportation Facilities	Pearson Correlation	.567**	1
	Sig. (2-tailed)	.000	
	N	201	201
**. Correlation is significant at the 0.01 level (2-tailed).			

$H_0$2: There is no relationship between transportation schedule and transportation facilities.

H_a2: There is a relationship between transportation schedule and transportation facilities.

The relationship between transportation schedule and transport facilities was investigated. There is a large positive correlation between the two variables, $r = .567$, $n = 201$, $p < 0.01$. The researcher rejects the null hypothesis which states that there is no relationship between the transportation schedule and transport facilities.

Table 4.4: Transportation schedule relates to transport timeliness

Correlations			
		Transportation Schedule	Transport Timeliness
Transportation Schedule	Pearson Correlation	1	.361**
	Sig. (2-tailed)		.000
	N	201	201
Transport Timeliness	Pearson Correlation	.361**	1
	Sig. (2-tailed)	.000	
	N	201	201
**. Correlation is significant at the 0.01 level (2-tailed).			

$H_0$3: There is no relationship between transportation schedule and transport timeliness.

H_a3: There is a relationship between transportation schedule and transport timeliness.

There is a medium relationship that exists between the transportation schedule and transport timeliness. In this correlation, r =.361, n = 201 and $p < 0.01$. This means that transportation schedule that suits any of the University school timetables is associated with a reasonable transport timeliness. The researcher rejects the null hypothesis which states that there is no relationship between the transportation schedule and transport timeliness.

Table 4.5: Transportation schedule relates to transport communication

Correlations			
		Transportation Schedule	Transport Communication
Transportation Schedule	Pearson Correlation	1	.346**
	Sig. (2-tailed)		.000
	N	201	201
Transport Communication	Pearson Correlation	.346**	1
	Sig. (2-tailed)	.000	
	N	201	201
**. Correlation is significant at the 0.01 level (2-tailed).			

$H_0$4: There is no relationship between transportation schedule and transport communication.

H_a4: There is a relationship between transportation schedule and transport communication.

From Table 4.5, there is a medium relationship between transportation schedule and transport communication variables, $r = .346$, $n = 201$, $p < 0.01$. The researcher rejects the null hypothesis which states that there is no relationship between the transportation schedule and transport communication.

Table 4.6: Transportation schedule relates to disabled commuters

Correlations			
		Transportation Schedule	Disabled Commuters
Transportation Schedule	Pearson Correlation	1	.156*
	Sig. (2-tailed)		.027
	N	201	201
Disabled Commuters	Pearson Correlation	.156*	1
	Sig. (2-tailed)	.027	
	N	201	201
*. Correlation is significant at the 0.05 level (2-tailed).			

$H_0$5: There is no relationship between transportation schedule and disabled commuters.

H_a5: There is a relationship between transportation schedule and disabled commuters.

The relationship that exists between transport schedule and disabled commuters was observed and examined using Pearson product moment correlation coefficient. There exists a small, positive correlation between the two variables, $r = .156$, $n = 201$, $p < 0.05$. The transportation schedule provided by the University management barely meets and suits the needs of the disabled commuters. The researcher noted that the disabled commuters are not catered for, as it should be. The researcher rejects the null hypothesis which states that there is no relationship between the transportation schedule and disabled commuters.

Table 4.7: Transportation schedule relates to sports arrangement

Correlations			
		Transportation Schedule	Sports Arrangement
Transportation Schedule	Pearson Correlation	1	.157*
	Sig. (2-tailed)		.027
	N	201	197
Sports Arrangement	Pearson Correlation	.157*	1
	Sig. (2-tailed)	.027	
	N	197	197
*. Correlation is significant at the 0.05 level (2-tailed).			

$H_0$6: There is no relationship between transportation schedule and sports arrangement.

H_a6: There is a relationship between transportation schedule and sports arrangement.

There is a small relationship between the transportation schedule and sports arrangement. In this correlation, r =.157, n = 201 and $p < 0.05$. The researcher rejects the null hypothesis which states that there is no relationship between the transportation schedule and sporting arrangements.

4.3.3 Descriptive statistics

Objective Two: To assess the influence of an integrated logistics network to optimise the transport services of the University.

Descriptive statistics were employed in this study to evaluate the respondents' perceptions from the questions asked. The subsequently selected descriptors are explained from the data analysis (mean, maximum, minimum, standard deviation, lower and upper bound confidence interval for mean and standard error).

Table 4.8: Descriptive Statistics of the Perceived Performance of University Logistics Supply Chain

		Statistics						
		TS	TC	TT	TFA	SA	TFLU	DC
N	Valid	201	201	201	201	194	201	201
	Missing	0	0	0	0	4	0	0
Mean		3.66	3.34	3.28	3.08	3.02	3.01	2.30
Median		4.00	4.00	3.00	3.00	3.00	3.00	2.00
Mode		4	4	4	3	4	3	1
Std. Deviation		1.080	1.102	1.145	1.191	1.218	1.100	1.242
Range		4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5

TS = Transportation Schedule, TC = Transport Communication, TT = Transport Timeliness, TFA = Transportation Facilities, TFLU = Transportation Fluctuations, DC = Disabled Commuters, SA = Sporting Arrangements

The descriptive analysis values show that the mean values range from 3.66 to 2.30 and as identified, mean values are determined using average control means. The variable (transportation schedule) has the highest mean value of 3.66, indicating that it is the best variable that contributes into overall transportation performance, as well as create value to the logistics networking at the University of KwaZulu-Natal. It also ensures defined output in terms of service quality. The respondents are happy that the transportation schedule provided by the University suits each school timetable.

The variable (transport communication) has a high mean score of 3.34. This indicates that respondents affirm that the transport arrangements are communicated in a suitable manner and are well undertaken. The transport structure in place adopts a positive medium to communicate with their users (mostly students) on its standard of use.

For the variable (Transport Timeliness), a mean score of 3.28 was recorded from the respondents. This means that the allocated time of travel is reasonable and aligns well with students' movement and schedule. The onus lies on the students to utilise these structures, made available by the University to improve their expected output (good results). A mean value of 3.08 was recorded against the variable (transportation facilities) from the respondents. This shows that the University of KwaZulu-Natal provides enough transportation facilities to align with the needs of the respondents. These facilities are believed to be manageable, hence; it is dependable on the students to utilise the facility.

The mean value of 3.01 noted by respondents in this research study with (sports arrangement) as the deciding variable, implies the adequacy in the provision of transport for special events. The transport system adds a colourful and meaningful approach to a balanced lifestyle for the students. They can access and attend special events without hitch about transportation. The respondents recorded a mean value of 3.01 in support of the variable (Transportation fluctuation). This indicates that the respondents agreed that the transportation schedule provided by the University caters for any hitch, slowdown and fluctuations. This ensures proper administrative assistance to students, hence guaranteeing the smooth running of transportation affairs by the University.

However, the lowest mean value of 2.30 for all variables relates to the variable (Disabled commuters). This indicates that providing and catering for disabled commuters was rated as the lowest variable on the performance of logistics networking in the University. It can also be that the disabled commuters are neglected.

4.4 Multivariate analysis

Objective Three: To establish the extent of the relationship between transport scheduling and transportation facilities.

4.4.1 Multiple Regression

Brace, Kemp and Snelgar (2012: 206) defined multiple regression as "a statistical method that allows the forecasting of a variable mark in relation to several other variables". This statistical technique can be used to discover linear relationships between the predictor and criterion variables – that is when the relationship follows a linear line. From the analysis of multiple regression, the variable (transportation facilities) has the highest beta value thereby making it a prime contributory factor to the dependent variable (transportation schedule). Statistically, this shows that, when transportation facilities are available, the University's transport system will do everything to meet the students' school timetable schedule. The data analysis on the multiple regression table also indicates that there is a statistically significant probability that the variables (Transport Fluctuations and Transport Communication) contribute to the effect on transport schedule (dependent variable). Whether the influence is negative or positive is likened to the responses in Table 4.4. to Table 4.10. From the analysis, it can be deduced that if there are miscommunications on transport logistics in the University and fluctuations on timing and arrival of a transport, then definitely the University schedule will not be met. This proposition implies the need to take cognisance of the importance of the logistics stakeholders and their drivers to find a balance by communicating amongst themselves avenues to reduce transport fluctuations and optimally provide better services to the University students.

Table 4.9: Model Summary, ANOVA and Coefficients

Model Summary						
Model		R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1		.623	.388	.369	.858	2.156
Predictors: (Constant), Sports Arrangement, Transportation Facilities, Disabled Commuters, Transport Communication, Transport Timeliness, Transportation Fluctuations **Dependent Variable: Transportation Schedule**						
ANOVA						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	**Regression**	88.758	6	14.793	20.092	.000
	Residual	139.889	190	.736		
	Total	228.647	196			
Dependent variable: Transportation Schedule **Predictors: (Constant), Sports arrangement, Transportation Facilities, Disabled Commuters, Transport Communication, Transport Timeliness, Transportation Fluctuations**						
Coefficients						
		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	**Constant**	1.452	.252		5.770	.000		
	Transportation Facilities	.353	.066	.389	5.383	.000	.616	1.623
	Transportation Fluctuations	.221	.070	.225	3.180	.002	.641	1.561
	Transport Timeliness	.068	.064	.072	1.055	.293	.691	1.446
	Transport Communication	.140	.066	.143	2.121	.035	.713	1.403
	Disabled Commuters	-.054	.054	-.062	-1.011	.313	.848	1.180
	Sports Arrangement	-.038	.056	-.043	-.680	.497	.808	1.237
Dependent Variable: Transportation Schedule								

In Table 4.9 above, in determining the presence of multicollinearity, the values of Tolerance and VIF are used. Tolerance indicates the extent of variability of a particular independent variable that cannot be explained by other variables in a model. When the tolerance value is less than (.10), then multicollinearity possibly exists in the model. The second value (VIF – variation inflation factor), is proportional to the tolerance value, thereby its value must lie below 10. Hence, in Table 4.9, tolerance values for each of the independent variables are higher than .10. Additionally, the VIF values for all variables are well below the value of 10. Hence, the results of the study did not violate the assumptions of multicollinearity. The R squared value recognized in model 1 is 0.388 hence demonstrating the variation in Transportation Schedule as the predictor (independent) variable is added as part of the model. The adjusted R squared considers the number of variables used and the model fit to the data sample. Hence, the adjusted R square value is 0.369.

The Durbin Watson statistics result is 2.156. The actual value of the statistics should lie between 1.5 and 2.5. This study employs the ANOVA table to show if the multiple R in the population equals to zero. It is also used to assess the significance of the outcome. The ANOVA Table F statistics value is 20.092 with a significant *p*-value of 0.000. It can be seen from the table that only three variables attained the significance value of zero (0). A conclusion is drawn, that there is an association between the dependent variable (Transportation schedule) and these three independent variables (Transportation facilities, transportation fluctuations and transport communication). The result is also supported by the correlation data analysis carried out previously, whereby linear association direction amongst variables was observed.

Transportation facilities have the highest beta value of 0.389 thus making it the highest factor that contributes to the dependent variable when other variables are controlled. The significance level of the variable (Transportation facilities) at a 95% confidence interval is $p = 0.000$ which is less than 0.05. This means that when the transport facilities are unavailable the schedule of each school in terms of timetable cannot be met; therefore, performance is compromised in terms of quality of service provided.

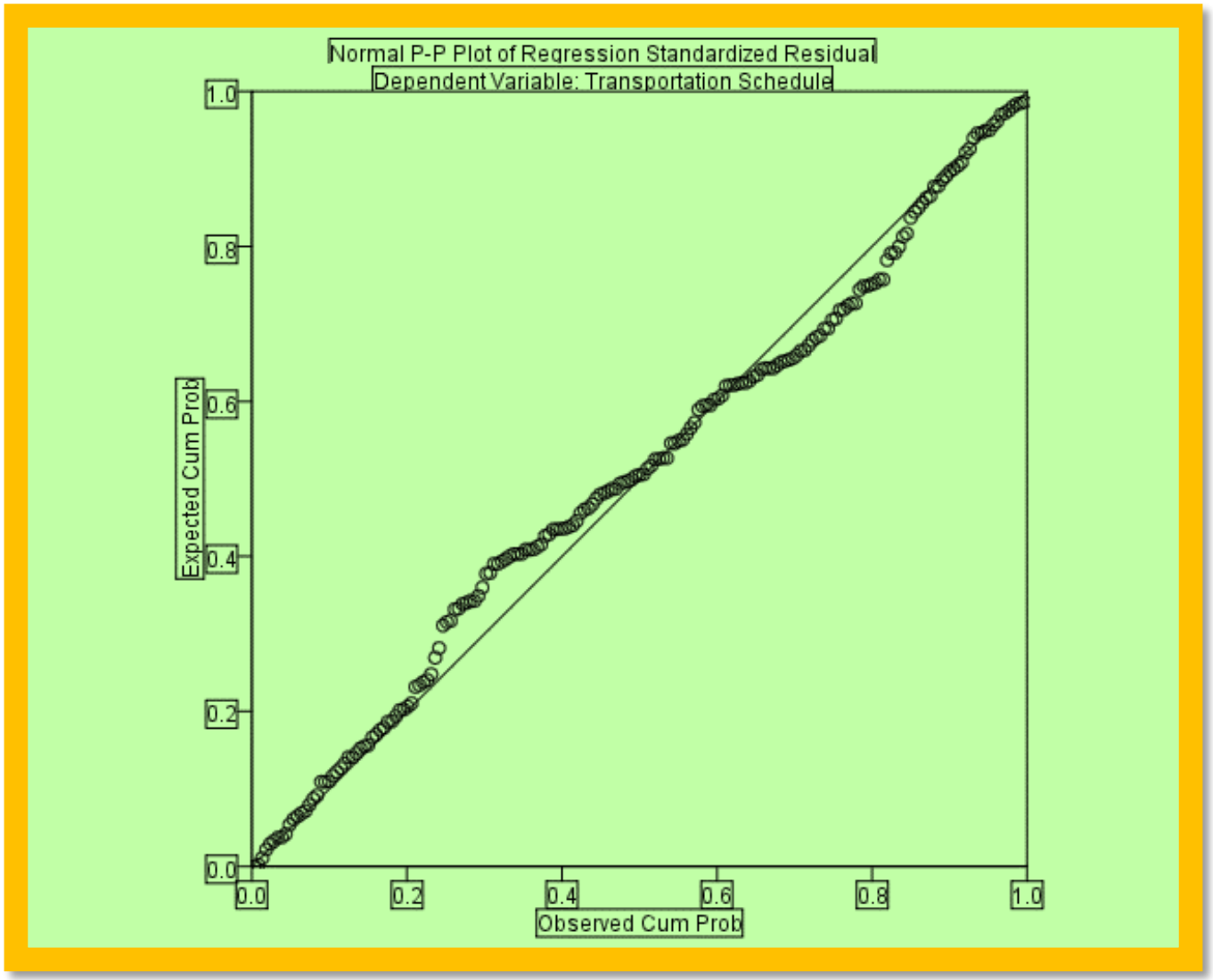
Table 4.10: Residual Statistics

Residuals Statistics[a]					
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1.98	5.14	3.65	.668	197
Std. Predicted Value	-2.492	2.203	-.003	.993	197
Standard Error of Predicted Value	.089	.303	.156	.044	197
Adjusted Predicted Value	2.06	5.14	3.65	.669	197
Residual	-3.916	1.893	.000	.844	197
Std. Residual	-4.563	2.206	.000	.983	197
Stud. Residual	-4.647	2.231	.001	1.004	197
Deleted Residual	-4.061	1.941	.001	.881	197
Stud. Deleted Residual	-4.923	2.255	-.001	1.015	197
Mahal. Distance	1.121	23.422	5.978	4.164	197
Cook's Distance	.000	.114	.006	.013	197
Centered Leverage Value	.006	.119	.031	.021	197
a. Dependent Variable: Transportation Schedule					

From Table 4.10, the standardised residual result is (min = -4.563 and max = 2.206) which lies between the expected value of (-3.3 and ±3) and a studentised residual (min = -4.647 and max =2.231). The model above includes a normal distribution with mean zero (-0.000) and standard deviation close to one (0.983) from the standardised residual row. The measurement of the cook's distance (D) describes the effect that an observation has on the entire model. When D >1, there is the existence of an outlier problem (Pallant, 2011: 160). The statistics analysis result from this study shows that the cook's value lies within (min = 0.000 and max = 0.114), thus the value of D is less than one, indicating that the observations do not really have many effects on the regression analysis and there is no outlier.

The Leverage observation takes a number that lies between 0 and 1. Zero (0) indicates that there are no issues or influence on the regression and 1 indicates that there are influences on the regression analysis. For this research study, the leverage level lies within a (min of 0.006 and max of 0.119). The Mahalanobis distance is used to detect outliers in a data by exploring the extent to which the total figure lies from the centre of all the predictor variables. The values comprise (min = 1.121 and max =23.422).

Figure 4.17: Normal P-P Plot of Regression Standardised Residual



Normality and Linearity

The normality and linearity plot of regression assures that mutual variances are not violated. A validity that represents assumptions about the residual values of a normal P-P plot follows a normal dispersion. The points on the straight-line points are the expected values from the data and it matches the diagonal line hence suggesting that there are no deviations from normality.

4.4.2 Factor analysis

Pallant (2011:186) describes factor analysis as an analysis that tries to discover a small set of factors that represents the actual association among groups of variables that are related. It is a form of reducing model. It does this by taking a large set of variables and then reduces them to a smaller set. For this research study, the exploratory type of factor analysis will be employed. The reason is that exploratory factor analysis process is utilised in the early stage of a study to pull up information or explore the interrelationship between some variable sets. This research study will employ the method known as principal component analysis (PCA). Through this method, the key variables are reduced into a smaller set but the associated factors are evaluated through an arithmetic method. Only the shared variances are usually analysed.

Table 4.11: KMO and Barlett's Test, Communalities, Total Variance and Rotated Component Matrix

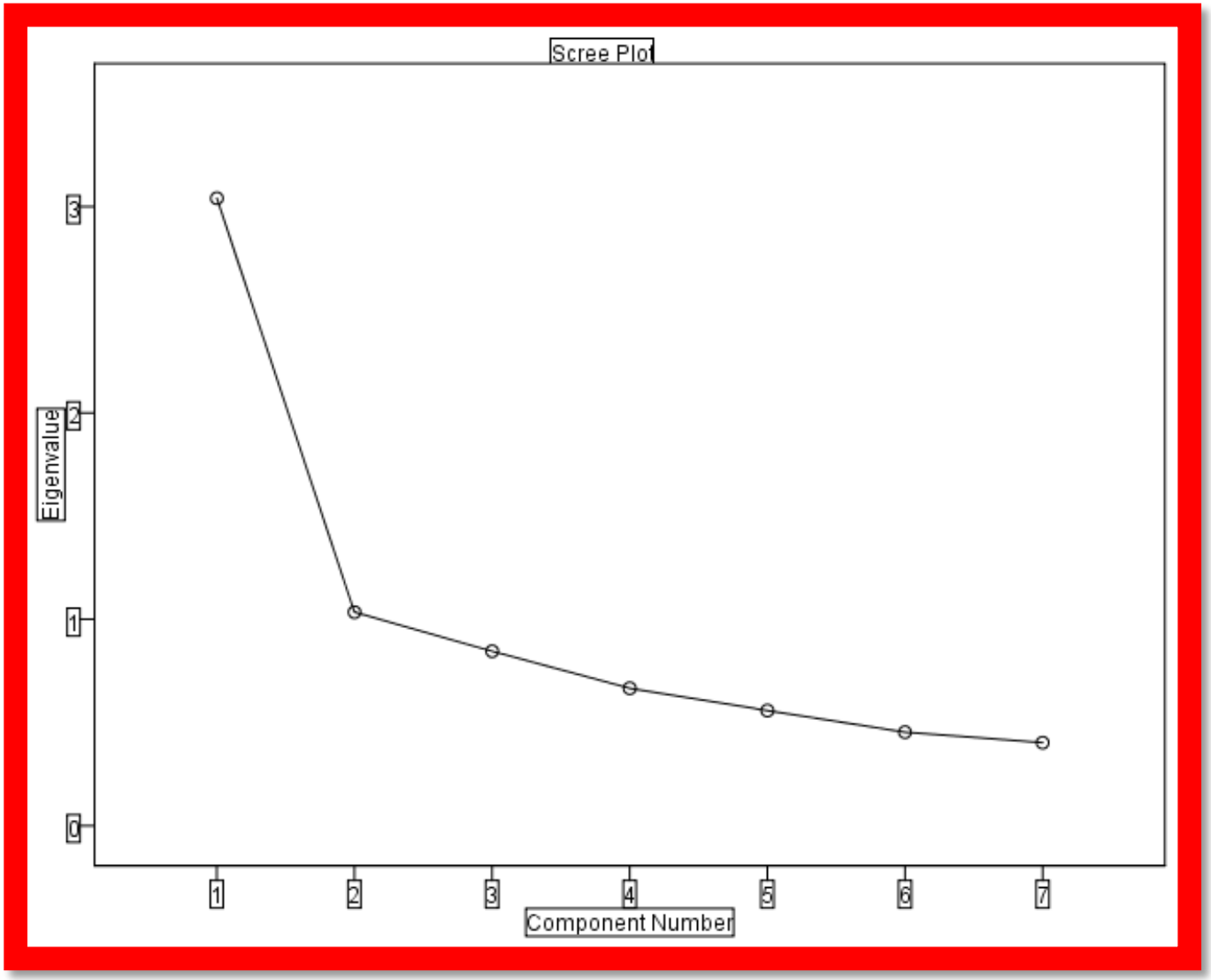
KMO and Bartlett's Test						
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.						.812
Bartlett's Test of Sphericity		Approx. Chi-Square				330.603
		Df				21
		Sig.				.000
Rotated Component Matrix						
	Factor Loading	**Eigenvalue**	**% of Variance**	**Cumulative %**	**Communalities Extraction**	**Alpha**
Factor One: modus operandi of the University transport system						
Transportation facilities	2.689	3.041	43.443	43.443	0.706	0.778
Transportation fluctuations	2.162	1.035	14.782	58.225	0.612	0.737
Transportation schedule		0.845	12.075	70.299	0.694	0.700
Transport Timeliness		0.666	9.512	79.811	0.489	0.696
Factor Two: Transport Communication						
Transport communication		0.558	7.969	87.780	0.515	0.649
Disabled commuters		.453	6.472	94.252	0.378	0.493
Sports arrangement		.402	5.748	100.000	0.681	0.653
''Extraction Method: Principal Component Analysis., Rotation Method: Varimax with Kaiser Normalisation.						

From this analysis, the KMO value is 0.812, and Bartlett's test has a significant value of (p = 0.000); therefore, the factor analysis is suitable at 21 degrees of freedom. The value for communalities usually lies between 0 to 1; hence, values that are less than 0.3 indicate that the item cannot be used in the analysis. In Table 4.11 above, the cell containing the communality extraction values are higher than 0.3; therefore, the selected items are fit to be included in the analysis.

Nevertheless, the interest of any researcher is always to find or select all the components that have an eigenvalue of 1 or more. In Table 4.11 above, only two components have eigenvalues that are higher than 1 (3.041 and 1.035). These two components describe 58.23% per cent of the variance extracted from the analysis. Often, it makes sense that one should look at the Scree plot. Scree plot allows one to clarify the number of components extracted from an analysis (Pallant, 2011:191). A change in the shape of the scree plot can be identified, but only the points that are above the shape break are retained.

Components 1 and 2 capture much of the variance than others. That is the reason why only two components are reserved. Every point on the graph appears in a descending direction of the recorded eigenvalue magnitude (Pallant, 2011:192). The absolute significance of the factors can be viewed from the scree plot. From Figure 4.18 below, the scree plot categorizes only two components as the most important components.

Figure 4.18 Eigenvalue Scree Plot



Interpretation of the factor analysis and Factor labelling

Component Correlation Matrix		
Component	1	2
1	1.000	.403
2	.403	1.000
Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization.		

The method of extraction of the factors used in this study is the parallel analysis and the type of rotation method used is the oblimin. The factors are 'rotated' by showing the outline of the loadings so that it becomes simpler to understand (Pallant, 2011: 199). Using the oblimin rotation, the principal component analysis reveals the two components with a high eigenvalue. The two components 58.23% of the variance. Component 1 contributes 43.44% and component 2 contributes 14.80%. There exists a moderate positive correlation between the two factors *(r = .40).* The outcome of this analysis supports the networking of transport at the University of KwaZulu-Natal. This is because, when there are fluctuations in the transportation needs of students, other facilities can opt to provide the services, which are all positive affecting items.

The explanation includes thus:

Factor one: Modus Operandi of the University Transport System

This factor includes the variables needed in the redesigning and restructuring of the logistics transport system in the University of KwaZulu-Natal. The components that make up these factors include transport facilities, transport fluctuations, transportation schedule and transport timeliness. These variables relate to the performance measures that uphold the logistics transport network to meet up with students' demands through the available resources. This factor relates to how the design of the transporting system is structured to meet students' demands and how it is flexible for students to cope with it and above all perform well despite any challenge.

Factor two: Transport communication

This factor includes three variables: transport communication, disabled commuters and sports arrangement. These variables are independent of each other, but a combination of them involves the day-to-day human interaction and exchange of information to care for the physically challenged and able students. Without a balanced human relationship, communication becomes difficult and set objective will not be achieved. Hence, the University must have in place a defined transportation system to serve the students and attain good performance quality.

4.5 Reliability and Validity

According to Pallant (2011: 97), a scales' internal consistency includes the magnitude to which the whole items or components that make up the complete scale interact together. It tests whether those items measure the same construct that it is meant to. The internal consistency of scales is called Cronbach's alpha coefficient and should be above 0.7. The reliability of any scale can alter but this relies on the sample data. For this study, the researcher will test the reliability of the instrument used by conducting the reliability statistics.

Table 4.12: Reliability Statistics

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.766	.770	7

Table 4.12a: Item-total statistics

Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Transportation Schedule	17.99	20.923	.504	.373	.734
Transportation Facilities	18.57	19.215	.607	.457	.710
Transportation Fluctuations	18.64	20.293	.561	.375	.723
Transport Timeliness	18.38	20.278	.526	.297	.729
Transport Communication	18.31	20.735	.497	.297	.735
Disabled Commuters	19.37	21.458	.352	.147	.767
Sports Arrangement	18.63	21.223	.380	.196	.761

From Table 4.12, the respondents were asked to respond to some questions on a five-point Likert scale where 1 stipulates 'strongly disagree' and 5 'strongly agree. Cronbach Alpha examines the reliability of the questionnaire and examines the internal consistency of a study. The range must lie between 0 and 1. If a value is closer to 1, a high internal consistency is attained. Reliability of a scale depends on the sample it is used for (Pallant, 2011: 98). The perceived performance and synchrony in the University logistics supply chain scale, has good internal consistency, with a Cronbach alpha coefficient reported of 0.766 and this value is above 0.7. Therefore, the scale is reliable for the sample analysed. In examining (7) variables on the five-point Likert scale, Cronbach's Alpha of the instrument is 0.766.

4.6 Independent-samples T-Test

An independent samples t-test is used when one wishes to liken the mean score on a continuous variable, with two unlikely groups of respondents or instances. This type of test tells one whether a statistically significant mean score difference exists between two groups. Statistically, it means that a researcher is testing the chance that sets of scores are from the same population (Pallant 2011: 240). In this study, the researcher wishes to test whether there is a statistically significant difference in the mean suitability of transport schedule for males and females.

Table 4.13a: Group Statistics

Group Statistics					
	Gender	N	Mean	Std. Deviation	Std. Error Mean
Transportation Schedule	MALE	124	3.77	1.003	.090
	FEMALE	77	3.47	1.176	.134

Table 4.13b: Independent Sample Test

		Levene's Test for equality of variances		Test for equality of means				
		F	Sig	t	df	Sig(2 tailed)	Mean Difference	Std Error Difference
Transportation schedule	Equal variances assumed	3.048	.082	1.971	199	.50	.307	.156
	Equal variances not assumed			1.899	142.172	.060	.307	.161

From Table 4.13b, an independent-samples t-test was carried out, to liken the transport schedule suitability for males and females of the University of KwaZulu-Natal. There is a statistical significant difference in scores for males (*M* = 3.77, *SD* = 1.003) and females (*M* =3.47, *SD* = 1.176; t (199) = 1.97, *p* = .50, two-tailed). The extent of the differences in the means (mean difference = 0.31, 95% C*I*: .00 to 0 .61) was very large (eta squared = 0.019).

The eta squared is calculated thus = $\frac{t^2}{t^2 + (N1+N2-2)}$

$$\frac{1.97^2}{1.97^2 + (124 + 77 - 2)}$$

Eta squared = 0.019

According to the guidelines found in (Pallant, 2011:243), to interpret the eta-squared value include:

0.01 = small effect

0.06 = moderate effect

0.14 = large effect

Hence, to express the eta squared value as a percentage, only 1.9% per cent of the variance on the suitability of the transportation schedule is explained by the gender variable. There is a large effect between the mean differences between males and females in this study.

4.7 Conclusion

This chapter has produced data on the analysis with regards to the integrated logistics network in enhancing logistics optimisation of the University of KwaZulu-Natal, off-campus residence students' transportation system. Data collection was carried out to assess if whether an integrated transport network system can be applied to improve and optimise services rendered to the students that are living in the residences. This was done by measuring the extent to which the needs of students are met by the current system. Some cross-tabulations, correlations and regression analysis were performed and substantiated. From the analysis, integrated networking will optimise the transportation system of the University by improving the movement of students in and around the city. As stated in the literature, integrated networks produce higher results in meeting the needs of users. Thus, optimising the logistics system through vertical and horizontal integration. From the factor analysis, the seven statements on perceived performance and synchrony in the University logistics supply chain were reduced to two factors.

CHAPTER FIVE
DISCUSSION OF RESULTS

5.1 Introduction

Chapter one of this thesis presented the study background, introduced the research objectives and questions with the research problem. Chapter two includes some literature reviewed on logistics networks, logistics system integration and logistics optimisation. Chapter three discusses the research methodology employed in the study, the collected data method and data analysis techniques. Chapter four includes the analysed data that were collected from the study participants using diagrams, tables and statistical reports. The research study objectives will be explained in this chapter. The research questions are also evaluated to provide study awareness. Firstly, the biographical information is considered, followed by the research objectives discussion. The study was motivated by the need to improve the University's student transportation systems along with the need for an integrated network.

5.2 Biographical Information Discussion

Most of the respondents were male students. Two hundred and fifty (250) questionnaires were distributed to the respondents and only two hundred and one (201) participated in the study, representing 80% return rate. Most of the respondents were male respondents with a sixty-two per cent (62%) rate of response and thirty-eight per cent (38%) were females. This suggests that male students are the ones that use the University transport system than females. Overall, most of the respondents that participated in the study are in their third year of study with a high response rate of fifty-five per cent (55%). Nineteen per cent (19%) of the respondents are registered students and are in their second year of study. The least represented group of participants with a rate of eleven per cent (11%) is in their first year of study. The second-year respondents seem to enjoy living off-campus, this can be so if they come from various provinces and are not be able to adapt to campus life. The researcher assumes that most students prefer to be on campus especially in their first year of study because they are still leaving their parents' home to another strange environment and need to acclimatise to the environment. Hence, when they are in their third year of study, they can stay off campus since they know their way around by then. It was noted that most respondents belong to the colleges of (Law and Management Studies and Agriculture, Engineering and Science) with a forty-seven and forty-six per cent (47% and 46%) respective response rate. The College of Health Sciences with a response rate of five per cent (5%) ensued and the last represented college is humanities with two per cent (2%) rate of respondents.

5.3 Discussion of Research Objectives

Objective One: To examine the effect of the process flow of the outsourced and insourced student transportation systems of the University.

Process flow analysis is a method of visually documenting the stages involved in performing a certain business procedure. Process flow documentation is vital for the monitoring of the quality of a product or a service. The documentation of process flows is done by observing specific sub-processes (stages) within the main process (business procedure) of the delivery of a good or a service (Schroeder and Goldstein, 2018). The decisions that are taken regarding the objectives of the process have a direct impact on the sub-processes (Schroeder and Goldstein, 2018). The process flow of an organisation is designed to meet the needs of customers in the best way possible. In the University's transportation of off-campus resident students, the process flow refers to the composition of a transportation schedule and the operational processes involved in meeting the transportation needs of students. The transportation schedule of the University is primarily designed to support academic activities. However, academic activities form only a fraction of the students' transportation needs. In the context of the operation of the transportation facilities, the process flow also involves the secondary elements in meetings overall students' transportation needs. The secondary elements refer to the extension of students' transportation needs beyond academic activities which are also catered for by the transportation facilities. For examining the effect of the process flow of the outsourced and insourced student transportation; the researcher relied on the correlation of various elements of customer needs which serve as objectives of the process flow. The researcher utilised a demand-side approach to quantify the students' perceptions of the elements of transportation systems of the University.

Transportation schedule assigned as the dependent variable was measured against various independent variables in the context of the performance of the transportation system. Firstly, a transportation schedule which caters to the needs of the students' school timetable was found to be moderately positively related (r = .48) to transportation fluctuations. This means that statistically, the transportation schedule caters for when students require to perform tasks which are outside of their school timetable as well. The process flow has a positive effect on these variables as it caters for both in a positive manner.

Secondly, the correlation between the transportation schedule which caters for the school timetable needs of students and the adequacy of transportation facilities which are utilised to meet the needs of students. There is a large positive correlation (r = .567) between the variables. This indicates that there is a strong positive relationship between the transport schedule and the adequacy of transportation facilities. The transportation schedule is the driver of the logistics network as cited in

the literature. One of the "functional decisions" in creating a transportation schedule is the allocation of vehicles (transportation facilities). In the process of the provision of a transportation schedule in UKZN, adequacy of transportation facilities has been met alongside with the demand of students respectively.

According to literature the time aspect "has to do more with the reliability of a transport network", as it "takes into account issues such as turnaround time, cycle time, lead-time and average travel time". When commenting on the timeliness factor of a transportation system, the various elements are taken into consideration. The provision of a transportation system in a timely manner, therefore, relates to the extent to which respondents feel that the time aspect of transportation is favourable. There is a medium positive correlation (r =.361) between a transportation schedule which is provided to meet the school timetable and provided transportation which works in a timely manner. This indicates that the relationship is not a strong one. Time is a very important factor as students carry out their core activities (i.e. Lectures, Tests, and Exams) according to precise timetables. The process flow does not provide the best solution in this regard given the precise nature of time.

According to literature communication is one of the main inputs to integration alongside information-sharing and trust. Within the process flow of the insourced and outsourced transportation system, there is a medium positive correlation (r = .346) between transport schedule and transport communication. The positive relationship between the variables indicates that the transportation schedule which is suitable for the students' school timetable is favourably aligned with transportation arrangements being communicated in a suitable manner. The positive association between the two variables is favourable.

There is a small positive correlation (r = .156) between transport schedule which is suitable for the school timetable and transportation which caters for disabled commuters. The relationship being positive is a good indication of there being an agreeing alignment between the two variables. However, the extent to which the alignment exists does not reflect a positive impact from the process flow. The main point of the process flow is for there to exist a satisfaction of the users' needs. This statistic reflects the proclivity of there not being an emphatic provision of adequate transportation for students of all profiles.

On a balance of scales, the process flow of the outsourced and insourced student transportation systems of the University has a positive effect on the level of satisfaction of the respondents. This can be seen as there exists a positive correlation between the dependent and all the independent

variables. The variables can also be seen as an interpretation of the performance of the transportation system, which is outlined by the process flow.

Objective Two: To assess the influence of an integrated logistics network to optimise the transport services of the University.

To address this objective, various components were considered to assist in describing the influence of an integrated logistics network in optimising the transport services rendered at the University. Firstly, the literature description of an integrated logistics network plays a vital role. It states that an integrated logistics is "the process of identifying users' wants and needs", and then compiling the compulsory resources to meet those wants and needs. Further, it also involves "optimising the network of resources and utilising the network to fulfil users' requests in a timely manner". Additionally, integrated logistics networks comprise of "a joint establishment of decisions, objectives, planning, and information sharing". The student transportation network of the University comprises of various vehicles which are owned by multiple parties. The University's staff and students are the users of the transportation network. An integrated network in this context would comprise of horizontal or vertical or a combination of both forms of integration. Horizontal integration of the University's student transportation network means collaboration between the various operators in the student transportation network (insourced and outsourced). The vertical integration on the other hand would entail joint decision making between users and key decision makers within the network. Integration would yield a network which encompasses characteristics of joint decisions, objectives, planning, and information sharing. Integration is consistent with meeting the customers' needs in the best way possible, therefore a demand-side approach has been implemented in assessing the influence of an integrated logistics network to optimise the transport services of the University. Students as customers were asked to rate specific tenets of an integrated logistics network which in turn influence optimisation of the network.

To understand the influence of an integrated logistics network to optimise the transport services of the University. The tenets of integration which result in the optimised usage of the transport services had to be measured. The researcher used a demand-side approach to understand the notion of the extent to which the tenets of an integrated logistics network influence the optimisation of the usage of the transportation system in the University. The elements measured are outlined in the descriptive statistics. The researcher probed the users' perception of the transport schedule, transport communication, transport timeliness, transport facilities, transportation fluctuations, disabled commuters, and sporting arrangements as tenets of integration.

When asked to rate the provided transportation schedule's suitability for their school timetable, the mean value of 3.66 was obtained from the users' responses. The users are adequately satisfied with the transportation schedule in this regard. Understanding that as much as the school timetable is the primary need for students; yet does not cover the full breadth of needs to be catered for by the transport schedule. The researcher also examined the users' perceptions of how the transportation schedule caters to any fluctuations according to their needs. There was a recorded mean of 3.01, an above average rating. To probe the compilation of the compulsory resources in meeting users' needs in the logistics network, users were asked to rate the adequacy of the facilities in fulfilling their transportation needs. A mean value of 3.08 was recorded. This means that there is an above average rating of the level of satisfaction in the manner in which these needs are fulfilled in this regard. Information sharing is one of the pillars of integration, hence the researcher made an enquiry regarding the users' perception of the transport communication. There was a recorded mean value of 3.34, this indicates a satisfaction by the majority in the suitability of communication. This a positive portrayal as communication is the vehicle for information sharing.

The fulfilment of the users' needs in a timely manner can be seen as an optimisation result of an integrated logistics network. To examine this element, the researcher asked students to rate the timeliness of the transportation provided. A mean score of 3.28 was recorded, meaning that the respondents are happy with the performance of transportation in this regard. In catering to students' needs, inclusivity must be considered. To probe this element the researcher asked the users to rate the way the transportation caters for disabled commuters. A below average mean of 2.30 was obtained. This means that the students feel that the transportation system doesn't cater enough for their disabled colleagues. This points towards a poor performance in this regard.

The literature states that the "principle of optimisation is minimising or maximizing a measurable objective function by altering values of a set of measurable constraints", further optimisation techniques are said to contribute toward attaining the most favourable solutions in a logistics network. The optimal outcome comprises of the attainment of minimised opportunity cost. The descriptive results show that the varied elements of students' needs satisfaction are met mostly on an above average scale.

Objective Three: To establish the extent of the relationship between transport scheduling and transportation facilities.

During the process of transportation network design, transport scheduling is used for the allocation of transportation facilities. When drawing up the transportation schedule (timetable), the University's student transportation key decision makers must consider the number of vehicles available for this function. A slight mismatch between transportation scheduling and transportation facilities could result in more empty seats or overloaded buses. A mismatch between the two variables could also lead to more unwanted results through a bullwhip effect. Understanding the students' perceptions of the two variables is vital as they are the users of interest in the transportation network in this study.

The transportation schedule of the transportation system of the University represents a tool through which transportation facilities are rolled out to students. There was a strong positive correlation analysed between the adequacy of transportation facilities and the way the transportation schedule caters to the students' school timetable (r = .567). The extent of this relationship can be further investigated by means of utilising multivariate analysis.

Multivariate analysis, a statistical technique that can be used to discover linear relationships can be used to address this objective. Transportation facilities as a variable was observed to have the beta value of 0.389 amongst other independent variables. Statistically, this means that the when students are happy regarding the adequacy of transportation facilities, they are also going to be happy about how their transportation schedule meets their timetable needs. To maintain students' high satisfaction, adequate facilities have to be provided since the two have proven to have the strongest relationship.

Objective Four: To assess the perceived performance outcomes of selected logistical systems against the expectation of the selected stakeholders.

From the questions presented in section B of the questionnaire, various transportation performance related questions were posed towards the students. Allowing for flexibility in terms of transport schedules gives a primal opportunity to all students to plan for themselves the best time to use the transport facility provided by the University. Although there are different opinions by the participants, whether their preference is on arriving on campus earlier or later, the transportation system allows for a dynamic adjustment from students to suit their needs. Hence, thirty-six per cent (36%) (a majority) of the students agreed that the schedule of transportation provided for their school by the University is suitable and corresponds with their timetable. Also, forty per cent (40%) (a majority) response rate is recorded against the participants who agreed that transportation arrangements are communicated in a suitable manner. Despite this, however, seventy-nine per cent (79%) wish that they had a more flexible schedule, indicating a sizable room for further improvement. According to Sople (2012:178), companies and institutions alike are leveraging their logistics to enhance customer service level, accelerate the movement of products to market.

The author reiterated that "Logistics is amongst the prime enablers of trade and commerce growth in a country". Generally speaking, logistics network optimisation is concerned with getting materials, people and information in the right place and time, given a set of constraints and measure of performance. The data analysis depicts that a high rate of respondents is in support of arriving early on campus and departing later from campus (69% and 80% respectively). The students can explain this as persistence and the zeal to attain good academic standing. Hence, seventy-nine per cent (79%) of the respondents supported a flexible schedule, which can allow them the ample time they needed.

The practice of providing transport facilities for students outside the University improves student demand and complements their prospects in terms of being organised and responsible. This can also translate to good benefit for the stakeholders and businesses as well. Pressure is reduced for some drivers that may develop fatigue due to the continuous strain from driving back and forth to campus. The researcher believes that once the process involved in the logistics network in the University are harmonised, then the demands from the student will be sorted. A flexible transport schedule can be managed through an information hub by disseminating the status of all transport system to all stakeholders involved. This supports the argument by Ozkir and Basligil (2013) that the logistics industry exhibits an endless technological environment with defined innovation. Students responded negatively regarding the adequacy of transportation facilities for the needs of their residence. Twenty-seven per cent (27%) of the respondents disagreed to the statement which states that "the University

has provided enough transportation facilities to suit the needs" of their residence. This negative response strongly calls for concerns from the University management. Hence, it is imperative that the University management with the transport system stakeholders offer them an avenue to ameliorate their services. As a student, the researcher believes preference of a flexible schedule allows students to maximise their time better rather than rushing off campus due to transport time constraints.

Respondents mostly agreed that transport schedule provided by the University is suitable for their timetable, transportation provided works in a timely manner, suitable transport communication arrangement is available and provision of adequate transport for sport and special events is catered for. This observation is in line with the argument of Chanintrakul, Mondragon, Lalwani, and Wong (2009), which purports that the most successful organisations have the ability to recognise the needs of the customer (students) and consumers' needs and to accurately implement them in a timely manner. In contrast to the positive demeanour of the respondents, are their neutral responses. These responses relate to the provision of adequate transport facilities and catering for fluctuations to suit student needs. The data analysis gives a unique observation. It shows that when fluctuations exist in the transport logistics system of the University and adequate transport facilities are not available, the quality of service is compromised. This can lead to mistrust by the respondents and can have a negative aura for the transport organisation. A high rate of thirty-eight per cent (38%) responses were recorded against the variable that involves the provision of transportation to cater for disabled commuters. The respondents disagreed that the commuters who are disabled were sufficiently taken care of. It is important to note that the right of any commuter should be upheld. It is preferable for the University to provide transports that are user-friendly for the disabled students. Additionally, a good transport system is an efficient logistics system that enhances performance and ensures minimisation of time.

5.4 Conclusion

To conclude, the transport logistics network system of the University of KwaZulu-Natal has been analysed. The use of this transporting system involves the services rendered to the students that live off campus. The research looked at the influence of integrating the transport network systems. The objectives of this research study were achieved, and it is interesting to know that integrating all the transport system of the University together will lead to optimal performance and benefits.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

Integrated logistics networking is a buzzword in the South African logistics landscape. Major cities around the country are making efforts to attain the best community-based integrated logistics networks. This study contributes to the area of integrated logistics through exploring the opportunity of it in contributing towards optimisation of logistics and transportation networks. This study assesses the logistics networks optimisation by looking at the transportation system of the University of KwaZulu-Natal's Westville campus' off-campus students' transportation system. The study has some limitations that have been identified; nonetheless, it identified key variables that have been tested and from which strong conclusions could be drawn. The knowledge that has been attained through the study opens doors to opportunities for future research, which could greatly benefit the logistics and public commuting industry.

6.2 Conclusion Based on Literature Review

The face of a logistics network can take many forms, ranging between fully insourced whereby an entity owns their own infrastructure, fully outsourced whereby an entity utilises a third or fourth party owned infrastructure, as well as networks that are hybrids encompassing certain elements from across the spectrum. The question of integration or an integrated network can be addressed by looking at the nature of a network as well as its management strategy. An integrated network comprises a jointly managed or a network that is fed with operational information from various stakeholders across the supply chain. This requires a form of communication that spreads across the integrated logistics organisation. The sharing of information allows various stakeholders to have their interests optimally met by a synchronously operated logistics network. Through a concept such as demand modelling, the supply and demand side aspects of a logistics network are brought to synergy. This model shows that through the adoption of algorithms a continuously self-correcting equilibrium level can be achieved. This equilibrium level is achieved through a synchronously operated logistics networks through which the demand-side and supply-side achieve the most optimum output. By virtue of modern technology timeous communication can be achieved when managing a complex integrated logistics network. There are several key performance indicators that may be monitored and benchmarked ensuring the best and most suitable running of a logistics network. A management structure supported by technology can also be used as a tool for communicating and facilitating the

management of an integrated logistics network. There are several platforms that are used in the modern era solely for managing the resources in a network. These include software packages that do not only help with management, but they also consider the tracking the adequacy of resources in a network, such as, the LIS, ERP, EDI, e-Hubs and TMS. All the aforementioned are some of the modern-day methods of economising resources in supply chains that are aimed at reducing waste from the perspective of all supply chain partners or stakeholders. In the case of this study, these are the demand-side and supply-side participants of the logistics networks. The adaptation of technology has been faced with some challenges, a lot which, as well as the industry as well as those that have done away, have overcome and gotten the best of some of the components of the technological sphere. However, technological backed by supply chain management conceptual advancement has proven to work in the industry's favour.

6.3 Conclusions Based on the Conducted Study

There was a common observation of a lack of robustness in the join operation and management of the network. The questionnaires that were designed to extract the demand-side notion of the extent to which their needs are being met were conducted. The study thereby examined the elements of integrated logistics networks by looking at how it has an effect on the modus operandi of the latter transportation systems. A system of juxtaposing the goals and benefits of an integrated logistics network and the current state of the latter network was used. The suggestion is that an integrated logistics network would be beneficial to create a balance and synergy, which is apparently currently lacking in the system.

Synchronisation refers to a state of synergy and cooperation amongst stakeholders that may be shown in various forms. Responses pointed towards a rigid method of operation without a continuous review of the ongoing needs of all stakeholders in the logistics network. The system adopted by key decision makers does not cater to the disseminated elements of students. This was shown in the quantitative study. The responses received from students show that the transportation system can prove to be counterproductive, as it does not allow them more time on campus to further their studies. Most students agreed that they would be happy to arrive and depart at times that are not provided by their transportation. Therefore, the synchronisation of the network is paramount and requires attention.

A timetable drawn once at one point in time is applied throughout the course of a semester. This timetable is then communicated all to stakeholders more especially the users of the transportation system. This can be seen in the study as well, the popularity that the timetable gains is apparent as most students indeed agreed that communication regarding the operation of facilities is adequate.

The bulk of the responsibility of ensuring utmost performance in the operation of the transportation facilities is left to the discretion of the service provider. This is taken into consideration at the beginning of a lengthy contract between an external entity and the University. The results from the quantitative study show that the safe operation of the transport network is mostly importation to students. It is important to ensure that this need is fulfilled. Consistent with the rigid arrival and departure times of the buses, it can be concluded that since most students wish to depart and arrive earlier, the buses that are the latest and earliest in departure and arrival could be prone to overloads which compromises the most important aspect of satisfactory performance of the network from the perspective of the end-user. This, therefore, advocates for a more flexible and timeous solution that will best fit the transportation requirements of the students.

The study recommends

- The movement towards modern technology for timeous communication between various stakeholders to facilitate optimisation of the processes.
- The creation of an information hub to share real-time information regarding the operation of the transportation network.
- To increase the flexibility in the transportation network to cater for fluctuations.

6.4 Contribution of the Study

This study is meant to contribute to the greater spectrum of integrated logistics networks, through its exploratory nature. It opens the concept to a wider audience as it caters for both management and users of a transportation or logistics network. The findings of this study advocate the modernisation of the University's transportation network by adopting more recently developed technology. This suggestion can be implemented in the transportation networks of larger enterprises. South Africa as a developing country is characterised as becoming secondary in the adaptation to the best that the modern world can offer. This study aims towards contributing to the placement of the country's infrastructure on the map.

6.5 Limitations of the study

The study is based on information that was gathered from participants who are based in the same region. The sample comprised heterogeneity amongst the selected individuals as students come from different colleges and fields of study. This posed a challenge whereby subjects did not fully understand the terms that are found in the field of supply chain management. Some respondents were

cynical towards providing responses citing the potential political implications of their responses, failing to understand or acknowledge the discrete and confidential nature of the data collection method. The researcher also came across an administrative difficulty with the approval of the ethical clearance with documents being mixed-up, costing the study months of delay. Due to spatial and logistical challenges, the study utilised only the readily available sample. This might cause hindrance in terms of the generalisability of the study's findings and results.

6.6 Opportunities for Further Research

The study explores a topic, which the researcher described earlier as a buzzword in South African commuters' logistics in general. This, therefore, sets a beginning for more explorations of similar nature. The tone has been set for more advanced studies that will include far more insightful notions improving from what has been discussed and founded in this study. The development of an integrated logistics network as the mainly recommended cause of action opens the opportunity for research in other more scientific areas. This study as part of a body of human science has exposed a need for the scientific-technological solution. The area of supply chain in its nature nurtures cross-functionality. This study thereby follows suit, in the footsteps by contributing to this ambience.

6.7 Conclusion

This research has provided an assessment of the influence that an integrated logistics network would have in optimising the transportation system of the University. The adaptation of such a system would have positive contributions given the modus operandi against the potential benefits of integration. Integration is meant to reduce wastage of resources thereby contributing to the optimisation of the transport network. The integration of the logistics network through the adaptation of modern technology can provide clarity in the supply chain, produced by effective information sharing and therefore optimisation. The extent of the relationship between transport facilities and transport schedule was observed to be strong.

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APPENDIX A

Questionnaire

CONSENT

I_____have been informed about the study entitled an Integrated Logistics Network to enhance Logistics Optimisation of the University of KwaZulu-Natal's, Off-Campus Resident Students' Transportation by Nduduzo Ngidi.

I understand the purpose and procedures of the study.

I have been given an opportunity to answer questions about the study and have had answers to my satisfaction.

I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without affecting any of the benefits that I usually am entitled to.

I have been informed about any available compensation or medical treatment if injury occurs to me as a result of study-related procedures.

If I have any further questions/concerns or queries related to the study, I understand that I may contact the researcher.

If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may contact:

Additional consent, where applicable

I hereby provide consent to:

Audio-record my interview / focus group discussion	YES / NO
Video-record my interview / focus group discussion	YES / NO
Use of my photographs for research purposes	YES / NO

_____ _____

Signature of Participant **Date**

Master of Commerce Research

Protocol reference number: HSS/1594/016H

Researcher: Nduduzo Ngidi (+2773 911 5363)

Supervisor: Mr T. P. Mbhele (+2731 2607 524)

UKZN College of Law and Management Studies

School of Management, Information Technology and Governance

Section A

Biographical information of respondent: Please indicate on the appropriate box

Quantitative Questions

1) Gender

Male		Female	

2) Please indicate your Year of study

1st year		2nd year		3rd year		Postgrad	

3) Please indicate your College

Agriculture, Engineering and Science	Health Sciences	Humanities	Law and Management Studies

Section B

The following questions are based on a Likert scale and relate to the perceived performance and synchrony in the University logistics supply chain. Please select the appropriate box, 1= strongly disagree, 2=disagree, 3=neutral, 4=agree and 5=strongly agree.

4) University provided transportation schedule is suitable for your school timetable (i.e. lectures, tests, exams).	5	4	3	2	1
5) The University has provided enough transportation facilities to suit the needs of your residence.	5	4	3	2	1
6) The transportation schedules cater for any fluctuations according to your needs.	5	4	3	2	1
7) The transportation provided works in a timely manner. (i.e. arrives on time, reasonable travel time)	5	4	3	2	1
8) Transportation arrangements are communicated in a suitable manner.	5	4	3	2	1
9) Transportation provided caters for disabled commuters	5	4	3	2	1
10) Transportation arrangements for sporting and other special events is provided adequately	5	4	3	2	1

This section contains dichotomous questions regarding the logistics network optimisation in the of logistics services of the University.

11) If you could, would you arrive on campus earlier?	Yes	No
12) If you could, would you depart from campus later?	Yes	No
13) If you could, would you arrive on campus later?	Yes	No
14) If you could, would you depart from campus earlier?	Yes	No
15) Would you be able to have a more flexible schedule if you wished?	Yes	No

Section C

Select three items and rank them from 1 to 3 in order of importance to you. 1 indicates "least important"; 2 indicates "moderately important"; 3 indicates "most important"

How do the perceived performance outcomes of selected logistical systems meet the expectation of the selected stakeholders?

Items	**Rank (1;2;3)**
16) The operation of the bus is safe.	
17) The bus driver is courteous and professional.	
18) The bus is clean and the condition of the bus is safe.	
19) Buses arrive on time.	
20) Availability of the information about the buses is.	

APPENDIX B

Frequency Distribution Tables

Section A: Biographical Information

1. Gender

		Frequency	Percent
Valid	MALE	124	61.7
	FEMALE	77	38.3
	Total	201	100.0

2. Year of study

Year of study

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Postgrad	29	14.4	14.4	14.4
	3rd year	111	55.2	55.2	69.7
	2nd year	39	19.4	19.4	89.1
	1st year	22	10.9	10.9	100.0
	Total	201	100.0	100.0	

3. College

College

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agriculture, Engineering and Science	94	46.8	47.0	47.0
	Law and Management Studies	93	46.3	46.5	93.5
	Health Sciences	10	5.0	5.0	98.5
	Humanities	3	1.5	1.5	100.0
	Total	200	99.5	100.0	
Missing	99	1	.5		
Total		201	100.0		

Section B: Likert scale questions

4. Transportation schedule

Transportation Schedule

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	48	23.9	23.9	23.9
	Agree	72	35.8	35.8	59.7
	Neutral	55	27.4	27.4	87.1
	Disagree	16	8.0	8.0	95.0
	Strongly disagree	10	5.0	5.0	100.0
	Total	201	100.0	100.0	

5. Transportation facilities

Transportation Facilities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	31	15.4	15.4	15.4
	Agree	42	20.9	20.9	36.3
	Neutral	57	28.4	28.4	64.7
	Disagree	55	27.4	27.4	92.0
	Strongly disagree	16	8.0	8.0	100.0
	Total	201	100.0	100.0	

6. Transportation fluctuations

Transportation Fluctuations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	19	9.5	9.5	9.5
	Agree	48	23.9	23.9	33.3
	Neutral	67	33.3	33.3	66.7
	Disagree	50	24.9	24.9	91.5
	Strongly disagree	17	8.5	8.5	100.0
	Total	201	100.0	100.0	

7. Transport Timeliness

Transport Timeliness

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	29	14.4	14.4	14.4
	Agree	64	31.8	31.8	46.3
	Neutral	58	28.9	28.9	75.1
	Disagree	34	16.9	16.9	92.0
	Strongly disagree	16	8.0	8.0	100.0
	Total	201	100.0	100.0	

8. Transport communication

Transport Communication

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	23	11.4	11.4	11.4
	Agree	81	40.3	40.3	51.7
	Neutral	55	27.4	27.4	79.1
	Disagree	25	12.4	12.4	91.5
	Strongly disagree	17	8.5	8.5	100.0
	Total	201	100.0	100.0	

9. Disabled commuters

Disabled Commuters

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	12	6.0	6.0	6.0
	Agree	20	10.0	10.0	15.9
	Neutral	62	30.8	30.8	46.8
	Disagree	30	14.9	14.9	61.7
	Strongly disagree	77	38.3	38.3	100.0
	Total	201	100.0	100.0	

10. Sports arrangement

Sports Arrangement

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	20	10.0	10.2	10.2
	Agree	59	29.4	29.9	40.1
	Neutral	50	24.9	25.4	65.5
	Disagree	40	19.9	20.3	85.8
	Strongly disagree	28	13.9	14.2	100.0
	Total	197	98.0	100.0	
Missing	99	4	2.0		
Total		201	100.0		

Section B: Dichotomous questions

11. Campus early arrival

Campus Early Arrival

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	139	69.2	69.5	69.5
	No	61	30.3	30.5	100.0
	Total	200	99.5	100.0	
Missing	99	1	.5		
Total		201	100.0		

12. Campus later departure

Campus Later Departure

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	161	80.1	80.9	80.9
	No	38	18.9	19.1	100.0
	Total	199	99.0	100.0	
Missing	99	2	1.0		
Total		201	100.0		

13. Campus later arrival

Campus Later Arrival

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	125	62.2	62.8	62.8
	No	74	36.8	37.2	100.0
	Total	199	99.0	100.0	
Missing	99	2	1.0		
Total		201	100.0		

13. Campus early departure

Campus Early Departure

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	127	63.2	64.5	64.5
	No	70	34.8	35.5	100.0
	Total	197	98.0	100.0	
Missing	99	4	2.0		
Total		201	100.0		

14. Flexible transport schedule

Flexible Transport Schedule

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	159	79.1	79.9	79.9
	No	39	19.4	19.6	99.5
	4	1	.5	.5	100.0
	Total	199	99.0	100.0	
Missing	99	2	1.0		
Total		201	100.0		

Section C: Rank questions

15. Safe bus operation

Safe Bus Operation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Most Important	128	63.7	66.7	66.7
	Moderately Important	49	24.4	25.5	92.2
	Least Important	15	7.5	7.8	100.0
	Total	192	95.5	100.0	
Missing	99	9	4.5		
Total		201	100.0		

16. Courteous bus driver

Courteous Bus Driver

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Most Important	106	52.7	55.8	55.8
	Moderately Important	66	32.8	34.7	90.5
	Least Important	18	9.0	9.5	100.0
	Total	190	94.5	100.0	
Missing	99	11	5.5		
Total		201	100.0		

17. Safe bus

Safe Bus

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Least Important	23	11.4	12.2	12.2
	Moderately Important	73	36.3	38.8	51.1
	Most Important	92	45.8	48.9	100.0
	Total	188	93.5	100.0	
Missing	99	13	6.5		
Total		201	100.0		

18. Timely bus arrival

Timely Bus Arrival

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Most Important	109	54.2	55.9	55.9
	Moderately Important	52	25.9	26.7	82.6
	Least Important	34	16.9	17.4	100.0
	Total	195	97.0	100.0	
Missing	99	6	3.0		
Total		201	100.0		

19. information availability

Information Availability

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Most Important	89	44.3	49.2	49.2
	Moderately Important	60	29.9	33.1	82.3
	Least Important	32	15.9	17.7	100.0
	Total	181	90.0	100.0	
Missing	99	20	10.0		
Total		201	100.0		

APPENDIX C

English Specialist Report

EDITORIAL

CERTIFICATE

Author/s: Nduduzo Ngidi

Document title: An Integrated Logistics Network to enhance Logistics Optimisation of the University of KwaZulu-Natal's, Off-Campus Resident Students' Transportation

Date issued: 04/12/2017

SUPREME EDITOR

This document certifies that the above manuscript was proofread and edited by Dr Gift Mheta.

The document was edited for proper English language, grammar, punctuation, spelling and overall style. The editor endeavoured to ensure that the author's intended meaning was not altered during the review. All amendments were tracked with the Microsoft Word "Track Changes" feature. Therefore, the authors had the option to reject or accept each change individually.

Kind regards

Dr Gift Mheta

SUPREME EDITOR

APPENDIX D

Ethical Clearance

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

28 September 2016

Mr Nduduzo Christian Ngidi (210520468)
School of Management, IT & Governance
Westville Campus

Dear Mr Ngidi,

Protocol reference number: HSS/1594/016H
Project title: An integrated Logistics Network to enhance Logistics Optimisation of the University of KwaZulu-Natal's, off-campus resident students' transportation

Full Approval – Expedited Application

In response to your application received on 27 September 2016, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol have been granted **FULL APPROVAL.**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....
Dr Shenuka Singh (Chair)

/ms

Cc Supervisor: Dr TP Mbhele
Cc Academic Leader Research: Professor Brian McArthur
Cc School Administrator: Ms Angela Pearce

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