UNIVERSITY OF KWAZULU-NATAL

EMPLOYEE PERCEPTIONS ON ADOPTION OF AN INTELLIGENT PORT TERMINAL:

A CASE STUDY OF DURBAN PORT TERMINALS

By

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DECLARATION

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"Employee perceptions on adoption of an intelligent port terminal:
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ABSTRACT

The global financial crisis of 2007–2008, which caused a decline in economic activities leading to the 2008–2012 global recession, has led to the need for performance improvement techniques and effective cost reduction mechanisms to be implemented in operating port terminals. Ports in Durban have to come up with effective ways of revamping their operations and adoption of an intelligent port terminal is an alternative.

This study seeks to determine the challenges and limitations experienced with the current technology used for port terminal operations in Durban and the influence of technological, organizational and environmental factors on the adoption of an intelligent port terminal at ports in Durban. The findings from this will enable port terminals, which are planning to adopt an intelligent port to be aware of factors to be considered before embarking on the project.

The TOE theory was used in this study as it includes the environmental aspect, which is not covered by other technology adoption theories. The proposed research seeks to obtain appropriate study conclusions by adopting a quantitative research. Non probability sampling was used to select the suitable employees from port terminals in Durban to participate in this study. A questionnaire was used as an instrument to collect data, which was analysed with statistical package for the social sciences (SPSS).

The analytical tests carried out on the data include reliability and validity test, statistical tests; descriptive statistics (frequency distributions, mean and Standard deviation) and inferential statistics (Wilcoxon Signed Ranks test, Regression analysis, and the one sample *t*-test).

The study revealed that adequate technology needs to be acquired and emphasis should be on the compatibility and complexity of the technology as they have the biggest influence on the adoption of an intelligent port in Durban. Communication with stakeholders and IT skills retention are the most important organisational factors and customer readiness is the important aspect on environmental factors, which influence the adoption on an intelligent port terminal.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

3G	-	Third Generation
AIS	-	Automatic Identification System
BB	-	Break Bulk
BI	-	Business Intelligence
BMPH	-	Berth Moves per Hour
CCTV	-	Closed-Circuit Television
CHE	-	Cargo-Handling Equipment
CO_2	-	Carbon Dioxide
DCT	-	Durban Container Terminal
DOI	-	Diffusion of Innovations
ECT	-	Electronic Communications and Transactions
EDI	-	Electronic Data Interchange
EIMS	-	Enterprise Information Management Services
ERC	-	Ethics Research Committee
GMPH	-	Gross Moves per Hour
GPRS	-	General Packet Radio Service
GPS	-	Global Positioning System
GRI	-	Global Reporting Initiative
GSM	-	Global System for Mobile Communications
HPA	-	Hamburg Port Authority
ICT	-	Information Communication Technology
IoE	-	Internet of Everything
IoT	-	Internet of Things
IT	-	Information Technology

KPI	-	Key Performance Indicators
LAN	-	Local Area Network
LED	-	Light Emitting Diode
LTE	-	Long Term Evolution
MHPM	-	Man Hours per Move
MEMS	-	Micro Electromechanical Systems
MHPM	-	Man Hours per Move
MT/Y	-	Metric Tonnes per Year
NFC	-	Near Field Communication
OECD	-	Organisation for Economic Co-operation and Development
OEMs	-	Original Equipment Manufacturers
POPI	-	Protection of Personal Information
RFID	-	Radio Frequency Identification
Ro-Ro	-	Roll on -Roll off
RTG's	-	Rubber-Tired Gantry Cranes
SMART	-	Self-Monitoring Analysis and Reporting
STS	-	Ship-to-Shore
TAM	-	Technology Acceptance Model
TEUS	-	Twenty Equivalent Units
TOE	-	Technology-Organization-Environment
TOS	-	Terminal Operating System,
UTAUT	-	Unified Theory of Acceptance and Use of Technology
VTS	-	Vessel Traffic Service
WAN	-	Wide Area Network
WLAN	-	Wireless Local Area Network

CHAPTER 1 : INTRODUCTION

The global financial crisis of 2007–2008, which caused a decline in economic activity leading to the 2008–2012 global recession (Eaton, Kortum, Neiman & Romalis, 2010) has intensified competition between ports worldwide. This has led to the need for performance improvement techniques and effective cost reduction mechanisms to be implemented in operating port terminals so as to sustain development activities and improve their governance (Verhoeven, 2010). These factors have steered port terminals worldwide to implement the latest technology to increase productivity in their processes and grow their market share (Tongzon, 2001). In so doing ports that have not followed suit are losing out on their market share and becoming less profitable because of the increased competition (Notteboom & Winkelmans, 2001). The adoption of an intelligent port terminal is similar to implementing a new technology and is dependent on numerous factors (Cullinane, Wang, Song & Ji, 2006) (Tongzon & Heng, 2005), which includes (1) The technology the organisation possesses and the latest technology available on the market for the organisation to acquire and implement, (2) The organisations structure and how it inspires the adoption of a new technology and (3) The environment in, which the organisation carries out its business.

A definition of the key terms and concepts used in the thesis is provided as follows:

- Port terminal: - It is an assemble point were freight (goods, container and cars) are stored for processing to be moved to other destinations, usually it will be from one mode of transportation into another.
- Intelligent port terminal: - Uses the latest technology to facilitate the movement of freight faster, using low cost mechanism, which encourages the well-being of employees and the citizens living around the facility.
- Market share: - The percentage of total sales of an industry in the market owned by a specific organisation compared to its competitors.

1.1 Background of the study

Ports in South Africa are parastatals solely owned by the government and are located in three provinces namely Kwa-Zulu Natal, Eastern Cape and Western Cape. The Kwa-Zulu Natal Province, has the largest port terminal in the country and has two ports namely the Durban port terminal and Richards bay port. The Eastern Cape Province also has two ports, namely East London and Nqura. The Western Cape Province has three ports, which are located in Port Elizabeth, Cape Town and Saldanha Bay. These commercial ports are responsible for the movement of goods in and out of the country. Their operations include the movement of containers, minerals, fresh produce and automobiles.

Ports in South Africa have evolved over time from manually operating the terminals to using the current technological equipment and mechanisms, so as to improve performance and be more effective. The environment that these ports operate in has also changed as it has become more competitive. It no longer needs organisations with only the right equipment and systems, but also organisations with the ability to integrate systems, analyse the data and information available. This will enable them to predict future trends and plan efficient ways to accomplish these predicted activities (Felício & Caldeirinha, 2013).

An intelligent port terminal can enable an organisation to integrate all its operating components and systems, so that it can be able to analyse the data and information available using business intelligence (BI). This enables it to predict the future trends and help in planning and satisfying the requirements for the future. Competition between sea port terminals has reduced the prices for the services offered by the ports with the only viable option for most ports to survive being to move more volumes (Chen, Lee & Notteboom, 2013). The current operational set up has limitations to the amount of volumes ports can move as the land on, which ports are situated is limited (Carlo, Vis & Roodbergen, 2014) and the ports cannot be easily expanded to meet demand requirements. The only way to remain profitable being to move cargo quicker.

Automation is the most effective way to move cargo quicker (Maturana, 2004) as it will reduce delays and sluggish times. Fully automating port terminal operations ensures that activities carried out will be planned well (Yang, 2015) and there is predictable movement of cargo from one point to the next. The automation of port terminals can make them efficient in running their operations (Zehendner & Feillet, 2014) by enabling business intelligence to be fully implemented and utilised (Lokuge & Alahakoon, 2007).

1.2 The research problem

Port terminals in Durban have to come up with an effective way of revamping their operations and the adoption of an intelligent port terminal is a viable option of fulfilling this objective. The adoption of an intelligent port terminal is similar to adopting a new technology and is a phenomenon, which needs to be studied, so that if any inhibiting factors are discovered they can be addressed for the successful adoption of an intelligent port terminal. Many technology solutions implemented in organisations fail not because they are not the right ones or the best but because enough facts will not have been compiled of an effective way to implement the new technology.

This study will assess the factors, influencing the adoption of an intelligent port by port terminals in Durban. This study will also enable organisations operating port terminals in South Africa, which are planning to adopt an intelligent port terminal to be aware of the factors to consider before embarking on the project. It is a huge risk to embark on an exercise of this magnitude without taking into consideration all the necessary factors.

1.2.1 Main research questions

i. What are the challenges and limitations experienced with the current technology used for port terminal operations?

ii. What is the influence of technological factors on the adoption of an intelligent port terminal at port terminals in Durban?

iii. What is the influence of organizational factors on the adoption of an intelligent port terminal at port terminals in Durban?

iv. What is the influence of environmental factors on the adoption of an intelligent port terminal at port terminals in Durban?

1.2.2 Research objectives

v. To determine the challenges and limitations experienced with the current technology used for port terminal operations in Durban.

vi. To determine the influence of technological factors on the adoption of an intelligent port terminal at port terminals in Durban.

vii. To determine the influence of organizational factors on the adoption of an intelligent port terminal at port terminals in Durban.

viii. To determine the influence of environmental factors on the adoption of an intelligent port terminal at port terminals in Durban.

1.3 Significance of the study

This will help port terminals in South Africa especially those operating in Durban to be able to understand the factors, which influence the adoption of an intelligent port terminal in their environment, especially the technology it is currently using and the availability of advanced technology for port terminal operations. It will also assess if its organisational structure is suitable for the adoption of an intelligent port terminal and help assess if the operating conditions in Durban and South Africa are suitable for the adoption of an intelligent port terminal.

1.4 Justification of the study

In carrying out this study, the researcher will be able to analyse the suitable conditions for the adoption of an intelligent port terminal especially in relation to technology, the organisational structure and operating environments of port terminals in Durban and South Africa. Currently there is limited knowledge on whether these factors influence the adoption of an intelligent port terminal.

1.5 Conclusion

The study is organized into 6 chapters. Chapter 1, the introduction, provides an overview of the research including the background, research problem, research questions, significance and justification of the study. Chapter 2, literature review provides a comprehensive review of the literature and the theoretical framework used for the study. Chapter 3, research methodology provides the research methods and design for this study. Chapter 4, findings and interpretation presents the data, which was collected for the study and its interpretation. Chapter 5, discussion provides a detailed discussion of the findings from the data collected for the study. Chapter 6, conclusion provides a summary of the findings from the study.

CHAPTER 2 : LITERATURE REVIEW

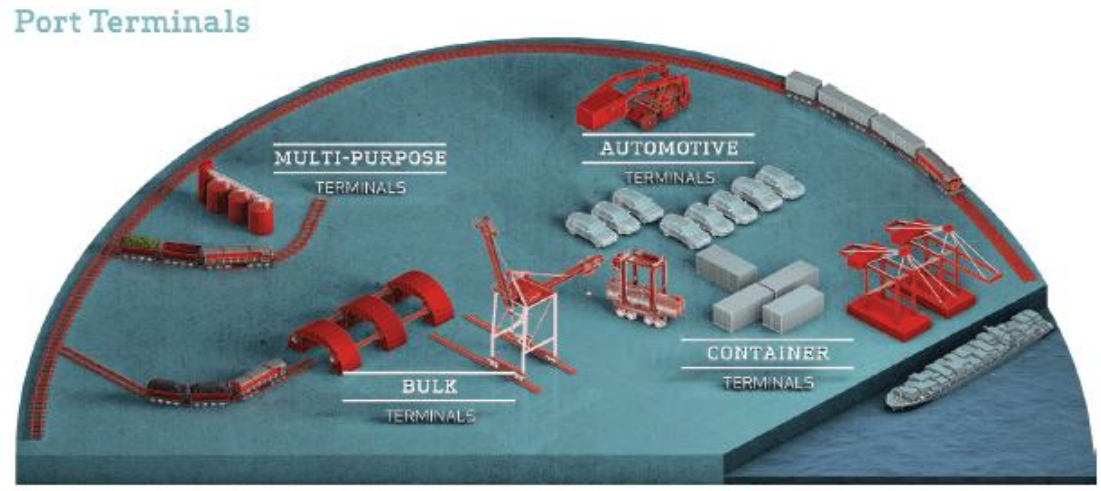
2.1 Introduction

This chapter covers reviews and analysis the literature covering port terminals. Major focus will be on reviewing literature related to port terminals, and the adoption of intelligent technology and what led to the need to adopt an intelligent port terminal. It will also highlight and compare the details, which have previously been studied and try to point out the gaps the literature does not cover. The theoretical framework used for this study will also be discussed in detail.

2.2 Port terminals

A port terminal is a place on the edge of the earth called a coastline with seafronts deep enough for ships to dock, so that goods and people can enter into ships for transportation through the sea (Verhoeven, 2010). Port terminals have been used from many centuries back as the points of entry, mainly for goods meant for trading purposes from one continent to another (Roso, Woxenius & Lumsden, 2009). Shipping is a mode of transport, which has been preferred over other modes of transport such as aircraft for many years for moving goods from one continent to another, as it allows a lot of goods and heavier equipment to be moved at a lower cost.

Most of the goods approximately 90% of the volume traded in the world is transported by sea, with almost 98% of the goods traded between South Africa and other nations moved through the sea (Lushnikov, 2003). The port terminals are very crucial as they facilitate trading between the Southern African region and the world. Their major function is to provide transportation logistics of goods between two places, then handling, storing and warehousing this cargo while it is in transit between the two points. These crucial services are provided by different shipping lines, freight forwarders and cargo owners (Pettit & Beresford, 2009). The port terminal operations can be categorised into four segments, which are containers, bulk (mineral resources), multi-purpose (break bulk) and automobile (cars) as depicted in Figure 2.1.



Source: http://www.overendstudio.co.za/online_reports/transnet_ar2014/integrated/pao_tpt.php

Figure 2.1: Types of port terminals

Port locations are carefully chosen to boost access to land and pilotable oceans. The best ports are located in areas where goods can be transferred faster to their intended destinations (Dwarakish & Salim, 2015). In addition, areas with commercial demand are the best for port locations as these areas usually have a larger population or are close to cities with a large population to create a commercial demand for the goods.

Ports with deeper water, which are protected from wind and waves are favoured, as they are able to accommodate bigger ships. With huger ships, which can transport many goods in one trip being built these days to reduce the costs of transportation, there is an increased demand for deeper ports and mechanisms for monitoring wind and waves (Zavadskas, Turskis & Bagočius, 2015).

Ports throughout history are used to handle different kinds of traffic from rail to road. This situation has changed with the modernisation of cities as regulations are being applied to protect the health of people living in the vicinity of the ports and to try to sustain the environment surrounding the ports (Muravev & Rakhmangulov, 2016).

The processes of a seaport can be reflected as a huge practice in which the ultimate component is not a noticeable artefact but fairly a quantified provision (Homayouni & Tang, 2015). The provision mentioned to is the supervision and packing of the containerized commodities for clients through the functioning depots (import and export) or transhipment depots, where products are moved from one container to the other. This provision requires to be accomplished on the period arranged with the client, and in agreement with the state of affairs that the vendor, broker and merchant has agreed with the client (Yu & Qi, 2013). The simple objective is to complete the tasks as fast as possible, to allow the container to occupy the least period necessary in the harbour and, therefore, to get maximum commercial use, as well as energy and to be ecologically effective.

2.3 Challenges and limitations faced by port terminals

Port terminals in Durban are currently facing several challenges and limitations in their day-to-day operational activities. These challenges range from technological, organisational and environmental issues. The technological issues include dilapidated IT infrastructure and inadequate computer systems. Organisational challenges and limitations include inadequate support from top management and lack of critical IT skills. On the environmental space, the challenges and limitations faced include the ever-changing environmental laws and labour relations acts, which need compliance by the organisation (CEO of Transnet Port Terminals, 2013).

2.3.1 Technology issues

The infrastructure used by port terminals in Durban has outlived its expected life span and it is no longer able to serve its intended purpose. Most of the ICT hardware currently being utilized such as servers, network infrastructure has outlasted their expected lifespan. The servers hosting port terminals ICT applications and databases are dilapidated and out of warranty with suppliers of the infrastructure no longer supporting the assets and parts for these are no longer easily obtainable. This has affected the performance of the ICT department in that it is not able to support the business effectively

in meeting its expectations (CEO of Transnet Port Terminals, 2013 & Pérez, Trujillo & González, 2016).

The network medium used to support business systems is the UTP twisted cable, which is not reliable enough to support current ICT operations for the business. The best network mediums are fibre-optic, WIFI or RFID networks as they are faster and support huge data bandwidth (Maspero, Van Dyk & Ittmann, 2008). With this current network setup, it will be difficult if not impossible to implement cloud computing. Sensors will also need to be around the terminals to complement the new medium of data transmission, as they can sense activities in the port operating vicinity and the data collected can be quickly sent to the terminal operating systems.

There is also a need to invest in latest tools of the systems used for operational purposes at port terminals in Durban. In particular, the SAP and Navis systems need to take advantage of mobile and business intelligence technologies, which when implemented will reduce costs of operating and maintaining ICT systems. These system enhancements will also add value to the business through quicker information generation and decision-making. Mobile intelligence enables data to be captured and transmitted in real time, while business intelligence allows it to be analysed and information generated instantly (Demirkan & Delen, 2013). This in turn will ensure that management has all the relevant information at their disposal to make effective decisions.

The port terminal operating systems are currently being used in silos, which is leading to huge costs of maintenance. They are also not being fully utilised with some processes for reporting and monitoring performances of terminal operations still being done manually. The integration of systems needs to be prioritised so as to fully automate processes in all terminals and reduce the human interference as much as possible. This will facilitate the implementation of predictive maintenance and automatic shift assignments in port operations, for example, when a shift worker clocks in and the system informs him which station to report to depending on capacity.

2.3.2 Organisational issues

Port terminals in Durban are currently facing some challenges, which are affecting business operation. These challenges include business process not being aligned to the computer systems currently being used for operations, lack of support from top management in terms of finance to invest in new IT initiatives and lack of willingness to change and adopt new ways of doing business. There is also a big issue concerning lack of critical IT skills and their retention (Trujillo, González & Jiménez, 2013).

Current business process in port terminals are not aligned to how operational computer systems operate, leading to some process being manually done leading to inefficiencies. The systems need to be aligned with business processes and there is a need for business process engineering to align port terminal process to current acceptable standards of port terminal operations. Most reporting is done manually due to systems not being integrated leading to inadequate information being provided for decision making (Ndlovu, 2007).

Communication is another challenge currently being faced at port terminals in Durban. There seems to be no clear communication between top level management and operational employees working at the bottom of the hierarchy (Ndlovu, 2007). There is need to develop a clear communication model, which will enable management to inform employees of what is the company's overall strategy, target goals for each year and what activities to concentrate on at each particular moment (Hall & Jacobs, 2010). The communication model should also empower employees to raise to management the challenges they are facing in completing assigned activities, meeting the expected targets and achieving the organisations overall objectives.

Information technology skills retention is another huge challenge the organisation is facing, because of the high demand for people with IT critical skills worldwide (Horwitz, 2013). At the moment the organisation is not able to attract skilled and experienced people with critical IT skills as they face competition from well renowned South African private companies and other organisations worldwide. The junior employees the organisation attracts do not stay for long in the organisation as they are then recruited by competitors once they have the necessary skills and experience.

Top management support is also required at port terminals in Durban in terms of financial support and encouragement to adopt new ways of doing things in the organisation. Currently there seem to be no enough financial support or drive from top management to encourage new ideas and implement changes to improve efficiencies. A culture change is needed especially from senior management as they are the ones in top positions and can influence the direction the organisation can take. A high performance culture which enables quick adoption of new effective ways of doing business is required (Ndlovu, 2007).

2.3.3 Environmental issues

Port terminals in Durban are facing huge competition from direct and indirect players in the port industry. Direct competition is coming from local organisation who are lobbying for the government to open up the seaport industry to everyone and not let it just be monopolised by a parastatal. Regional players are also posing a threat to port terminals in Durban as ports of Namibia, Mozambique and Tanzania are getting huge funding from the Chinese and Russian government to revamp their port terminals (Vhumbunu, 2016). This poses an indirect threat to port terminals in Durban as its regional customers might be taken away from them. Worldwide port terminals are identifying new routes which are faster and reliable for their delivery of goods so port terminals in Durban will have to be prepared to meet the new conditions expected by these international port terminals (Trujillo, González & Jiménez, 2013).

Government and municipality laws and regulations are also posing a challenge to ports of Durban operations. They are continuously being reviewed by the government and the municipality of Durban as they try to reduce energy usage, pollution radiation and carbon dioxide emissions. This is being done to protect the health and improve safety of people working at port terminals and staying in the surroundings of the seaport in Durban. Labour relations laws are also continuously being reviewed to ensure that individuals from previously disadvantaged backgrounds also have an opportunity of being employed. The challenge though is most do not have the relevant skills for the positions they are being placed.

Another challenge being faced is to satisfy the port terminals customers, these customers have expectations such as getting a quick and affordable service. They want to have their transactions processed online and in real-time so that they can be able to track and monitor their transactions throughout the process flow (Ndlovu, 2007). Processing customer transactions online will enable them to cut the huge printing costs associated with manually processing the transactions. The other issue is customers expect their confidential information to be secured safely during its processing which is not guaranteed through the manual process.

2.4 Intelligent port terminal

Intelligent technology or sometimes referred to as smart technology, which stands for "self-monitoring analysis and reporting technology" (Zanella, Bui, Castellani, Vangelista & Zorzi, 2014) is a technology that enable gadgets and devices to be capable of predicting future events. To be able to predict future events the devices or gadgets will have knowledge of all activities happening around them and affect their functioning.

For the gadget to be aware of all activities taking place around it, it is supposed to be connected and share data with other devices within its vicinity. Connection with gadgets close to each other makes communication and data networks valuable features for smart technology. Data, which is exchanged between these devices will have to be analysed and made to produce information, which can then be utilised to make pivotal decisions in carrying out the next activity (Ortiz, Hussein, Park, Han & Crespi, 2014).

The data collected can help to equip other devices on what next action to take or advice decision makers on what best decision to take (D'Orazio, Choo & Yang, 2017). An equipment in port operations can be programmed to take certain actions when a certain condition has been met, for example a crane might stop working when the wind is moving at a certain speed or in a specific direction. The crane might also be programmed to ring a siren when certain conditions have not been met while it is operating.

Intelligent/Smart technology is utilised in many situations in our daily lives, such as if you do not put your seat belt whilst driving the car warns you with a beeping sound. These gadgets if interconnected and can be able to pick all the relevant data and store it in a central database. The central stored data can then be accessed by other devices on real time and be used to come up with the next best decision to be implemented depending on the circumstances surrounding them ("Role of Big Data and Analytics in Smart Cities", 2016).

Dynamics such as spatial restraints, pressure to increase efficiency, economic restrictions and the necessity to be ecological add to the present trials of harbours (De Martino, 2014). Knowhow and inventions, such as the internet of things, can help to mitigate these challenges and be the driving force pushing the implementation of an intelligent seaport (Zhou, 2013). This kind of expertise, in the form of machinery and IT systems, can be the greatest means to get benefits in an intelligent seaport setting.

The final intelligent port could be the completely computerised seaport where every gadget is linked through the alleged internet of things, the main drivers in intelligent seaports are efficiency and productivity improvements. In port procedures there is a combination of numerous setups, in the form of equipment and systems (Gubbi, Buyya, Marusic & Palaniswami, 2013), that comprises diverse network tools like radio, LAN, WAN and WLAN, RFID, WIFI and positioning technologies.

The efficiency of the intelligent seaport depends on the equipment, skills, knowledge and the capability to be capable of working collectively and successfully share data, for the advantage of the seaport and its clients (Albino, Berardi & Dangelico, 2015). Data exchange is essential when stakeholders and the business need to strengthen a relationship and improve operations, as was the situation at the Cartagena port terminal.

An important component to all this is some sort of warehouse (cloud computing) collecting facts about every activity associated with port operations. Once studied and offered in a smart way, that information can assist in achieving the objective of undertaking things in a smarter way ("Role of Big Data and Analytics in Smart Cities", 2016).

This type of logistics machinery is approximately what the seaport of Hamburg has employed into its operational logistics plan. The purpose of this plan is to permit the port of Hamburg to advance intelligent resolutions for transportation and trade movements in order to improve the movement of data and competently manage goods movements at the port (Elsner, 2010). Table 2.1 illustrates the evolution of port operations from the 1940s to what is predicted of them by the year 2020.

1st Generation	2nd Generation	3rd Generation	4th Generation	5th Generation
1940s	**1960s**	**1980s**	**2000s**	**2020s**
Mechanic Port	Container Port	EDI Port	Internet Port	Intelligent Port
Mechanical Operation	Free Zone	International network	Global network	ITS port
Handcraft Works	Industrial Area	Integrated centre	Port Community	Logistic community
		Commercial area	Logistic area	Smart city
		EDI Services	Intermodal services	Smart Hinterland
			Internet services	Multi modal services
				Sustainable port

Source: https://www.slideshare.net/VijayHiranandani/port-operations-management-slideshow

Table 2.1: Evolution of port terminals

The vision of an intelligent / smart port terminal is a port that uses digital machineries to improve performance, reduce cost and resource consumption by taking care of people and being environmentally responsible. The belief of the intelligent port concept is creating the greatest usage of inadequate assets (roads, canals and railways) by bring together a mechanism that enhances today's control procedures of the transporters on land and ocean (Angelidou, 2014).

The growing cargo transportation capacities, budget burdens, monitoring necessities and the rising requirements for operations to be environmentally friendly all call for continuing operating procedure re-engineering in seaports operations (Ndlovu, 2007). These constraints can simply be encountered by those seaports that capitalise by investing in digitalisation and innovation automation. Subsequently seaports will not geographically expand continually they will have to come up with mechanisms to increase productivity whilst operating in their confined space.

Seaports should brace themselves for what is approaching, the volume of carriage in maritime transportation is projected to increase. Big seaports are the most important centres of this extremely vast movement of merchandises. This is where sea shipments, rail and highway need to put their heads together as this challenge is growing and threatening the logistics industry. It is vital to connect together real-time information amongst businesses, society, technologies and plants across diverse, naturally grown structures and its settings as the intelligent seaport is the vision (Ndlovu, 2007).

Hamburg port authority is facing two main drawbacks, the close proximity of the seaport to suburban spaces, and the huge amounts of commodities being moved (Pallis & de Langen, 2010). The current organisation's amenities should be used in an intelligent and effective way, as the area for continuously expanding is inadequate, launching intelligent infrastructure is now vital to guarantee smooth and well-organized traffic movements and eventually trade movements. Information technology mechanisms such as Bluetooth, hotspots or Wi-Fi, cloud computing, mobile end devices, IOT and big data play a key role in executing this (Dadashi, Wilson, Golightly & Sharples, 2014).

An intelligent port should provide a set of intelligent services, which combines the following characteristics (Ferretti & Schiavone, 2016):

- Intelligent and efficient use of current resources and infrastructures: The intelligent services should optimize the use of current resources, seeking mechanisms that facilitate the re-use of the infrastructure. The setup of collaborative environments is relevant to allow the stakeholders to share resources. The resources may be human resources, IT systems, premises, etc.

- Cost reduction: The gate automation would have a direct impact on the reduction of the staff assigned to gate control. Besides, the gate process time would be reduced, also queues and pollution would be also alleviated.

- Economic value: The intelligent services should create a clear return of the investment and produce economic value through a cost reduction or a new source of income.

- Time reduction: The gate in / out operation at gate terminal is currently under the supervision of terminal staff and police officers. The personnel assigned to these tasks has to check the hard copy documentation or the information prompted in their IT systems against physical items like the container number, truck plate, trucker identification. The control process takes time and slows down the gate in/out operation. Moreover, it creates truck queues at lanes with its negative impact on cost, time and pollution.

- Secure operations: The supervision and manual tasks are not free of errors and are harder to follow up and trace. The setup of automatic control at gates should guarantee the reliability and security of the port operations. The new systems would check that the operations are fully authorized.

- Improved working conditions: The people in charge of the supervision have to work outside or placed in small cabins. The gate automation process will allow to move people into well-equipped control offices.

- Environmental sustainability: The services will take into consideration environmental issues. It will contribute in reducing usage of limited resource and seek for the reduction of the CO_2 footprint.

- Health care responsibility: Millions of people work at port areas suffering tough conditions during their daily tasks. The intelligent services would bring about an improvement in working conditions. For instance, by providing mobility services and technologies, people can work in better premises.

- Governance: The intelligent services will enhance the good management of the ports improving security, safety and other key items such as ensuring the availability, traceability and smooth execution of the port operations. The intelligent services should strive for a better control of the tasks. In this way, it is key to have an efficient use of the human resources assigned to supervision tasks.

Hamburg port authority (HPA) established its long-standing intelligent port policy once they saw the breaks that it provides to their business, with the quick interchange of data in real time with all stakeholders to improve the value and competence of the seaport as a vital connexion in the supply chain through decisions made. The attention was focused on improving the port machinery, reduce traffic congestion and improve the efficiency in moving merchandise. HPA created the conception of adopting an intelligent port bit by bit and aimed to implement it through numerous projects (Notteboom, 2016). The costs of implementing an intelligent port concept has to be well thought out on a project-by-project basis.

Through innovation and computerisation, important port logistic developments can be pursued in real time and elastic replies are probable when needed. This decreases the threat of disturbances and in the end port set-up running through diverse means of transport carriers will be elevated to a new level (Swaminathan, 2015). For this resolution, the forthcoming seaport will have to entrench in its processes the internet of things comprising of sensors, systems and fast dependable processing of the data with the assistance of in-memory computing that will offer a precise representation of logistic procedures at all intervals. In this approach, big data will generate new planning guides and make seaport logistics extra effective.

2.5 Components of an intelligent port terminal

An intelligent port terminal has to have at least five mechanisms for it to be fully effective when functioning. These following mechanisms might be referred to as the main components of an intelligent port terminal.

- Internet of things for interconnecting all devices and gadgets around the terminal for quicker and easier exchange of data and information.
- Big data analytics tools for analysing data, which will be collected during port terminal operations (Shi, Tao & Voß, 2011).
- Data visualization for deducing meaning from the data analysed and presenting them in a form that business understands.
- Cloud computing for easier storage and retrieval of data and information for operational purposes.
- Pervasive computing giving intelligence to machinery in terminal operations so human intervention can be minimum.
- Information security to ensure that confidential information for port terminal operations is secure (Ao, 2014).

2.5.1 Internet of things (IoT)

Internet of things refers to the mutual connection between two or more devices embedded with electronics, computer programs, actuators and network connectivity, used for operational activities so that there can be rapid and transparent communication between them (Zanella, Bui, Castellani, Vangelista & Zorzi, 2014) as they will be transferring instructions to each other through the exchange of data and information (Gubbi, Buyya, Marusic & Palaniswami, 2013). IoT enables devices to be monitored and controlled remotely over the network thereby increasing efficiency, accuracy, productivity and economic benefit. The interconnection of these devices will be enabled by networks such as the LTE, infrared, Bluetooth, WIFI, satellites and other communication mediums (Perera, Zaslavsky, Christen & Georgakopoulos, 2013). IOT will:

- Interconnect both non-living and living things: - Equipment and devices used for port terminal operations such as cranes, haulers, trailers and straddle carriers can be connected together by the internet of things so that they are able to relay data, information and instructions to each other and sensors will have to be connected to these equipment and devices. Employee activities can also be tracked and their performance monitored on real time if IOT is embedded into operations, this can be done by attaching to them wearable digital fitness devices, these can be smart wristbands or vital jackets, which can check their heart rates, fatigue levels and be able to locate their position in the operational yard. (Abdelwahab, Hamdaoui, Guizani & Rayes, 2014).

- Use sensors for data collection: - The physical items that are being linked will have one or additional measuring device. Each measuring device will measure a particular circumstance such as position, movement, motion and heat. In IoT these measuring devices will link to each other and specific computer systems that can recognise or interpret information from the measuring device's data feeds, this process is what is referred to as data visualisation. These measuring devices will be fitted on port terminal machinery to measure details about their performance like fuel intake and the condition of the machinery for repair purposes and thereafter convey this information to port computer systems and reports created for the organisation to use to make resolutions.

- Enable gadgets to interconnect over an IP Network: - IoT empowered gadgets can exchange data about their state and their nearby surroundings with individuals, computer systems and other machineries. This data can be exchanged in real time or gathered and be exchanged at set times (Hasan, Hossain & Niyato, 2013). With IoT minimum human interventions will be required in terminal operations as machines can send instructions to each other to perform the next move when the other has completed its task.

2.5.2 Big data analytics

Big data examination is the practise of taking huge amounts of data in different forms then scrutinising it for the purposes of grouping it into similar types that meaningful information can be deduced from it. It involves the gathering of details, which affect port operations directly or indirectly and analysing it to acquire relevant information and knowledge (Kitchin, 2014). This can be used to reveal unseen and unidentified connections, business tendencies, client favourites and new valuable corporate facts from day-to-day activities to improve the way operations are being carried out (Khan, Anjum, Soomro & Tahir, 2015). These details include records of all activities happening in the port from the number of staff members, the skills they possess, the equipment owned by the port, their condition and life span (Fan & Bifet, 2013). The logical conclusions will lead to additional real promotion, fresh income breaks, improved client deals, better functioning throughput, modest benefit over competing establishments and new commercial profits. Also the details of the surrounding environment are pivotal to how the intelligent port terminal operates (Tien, 2013).

The main aim of big data analytics is to support businesses to make more informed business resolutions by allowing data experts, analytical modellers and other specialists to examine huge dimensions of business data, as well as other methods of records that may be unexploited by straight commercial intellect plans (Kumar, 2016). That might comprise of network server records and Internet clickstream statistics, common media content and community web accounts activities, writings from consumer electronic mail and assessment replies, mobile-phone call details and devices records taken by radars linked to the Internet of Things.

Big data can be studied by computer programs normally used as a measure of innovation, such as prognostic analytics, records quarrying, script analytics and arithmetic examination. Normal corporate intellect software and facts visualising apparatuses can also show a part in the investigation procedure. The partial organised and formless data may not fit well in old-style data silos built on old records (Almabhouh, Saleh & Ahmad, 2011).

2.5.3 Data visualisation

Data visualization is the pictorial presentation of intellectual facts for serving many functions including sense making (data analysis) and sending a clear message. Significant stories reside in the data circulated between us on a daily basis and data visualization is an influential tool to ascertain and recognise these stories and then portray the messages to others in a way they understand. Data visualization is having the ability to interpret the data (Kim, Shin, Choe, Seibert & Walz, 2012), which will have been gathered during the process of big data analytics (Cardone et al., 2013), as the data comes in different forms and requires the correct mechanisms to interpret it. These mechanisms would then support the inter-communication between the port terminal equipment (Gil-Garcia, Pardo & Nam, 2015) to help them exchange data and understand the data sent from one equipment to the other.

Data visualisation can improve the optimisation of traffic management and quarry side operations by monitoring traffic flows in the port operating environment (Zhang et al., 2011). Data visualisation can be used to enhance traffic management in the following areas at a seaport terminal: -

- Creating an incident management computer system
- Real time car park management system within the port provision.
- Creating an information centre to manage traffic.
- Vigorous road traffic controlling through adaptable communication symbols.
- Traffic flow control on roads approaching the terminal through pre-gate car parks.

The Hamburg port authority (HPA) has introduced the seaport traffic controlling system to sort the current highway to be well-organized and enhance transportation movements. A vigorous road traffic capacity statistics computer system is the first stride towards achieving intelligent traffic management. Vehicle drivers are informed on time about traffic jams, accidents and road closures and planned closure times of the roads and bridges in the port.

2.5.4 Cloud computing

Cloud computing is the catchphrase used to label diverse setups in, which computing services are distributed as a package over a network link (commonly the internet). It is therefore a kind of computing mechanism that depend on distribution a pool of physical and simulated resources, instead of setting up home-grown or individual infrastructure and computer systems (Lee, 2013). Customers are capable to tap into a stream of computing services and infrastructure than setting up their own infrastructure and building their own systems. It is much in the similar to the technique of a customer obtaining their power source from the national electricity supply, instead of generating the power source from their own making e.g. a generator.

Cloud computing will help with the storing of data to an easily accessible medium by all devices (Ercan, 2010), as the sharing of data will be pivotal for the successful adoption of the intelligent port terminal. It will enable the interlinking and management of the services and functions offered by different providers via the applications stored on the cloud. Haulage drivers and operators will be given tailored road traffic and port operations facts concerning the movement of traffic in the port vicinity and on the auto gates, closing periods of mobile channels and other groundwork information. The state of affairs at the seaport depots and all other terminal operations like empty container stacks and parking bays can be shared with outside stakeholders and business partners in advance.

Data of all events and activities that affect and influence the port operations include transport movement, weather conditions and operations at other terminals. This data will be easily accessible if all stakeholders which do business with port terminals in Durban agree to store it in the cloud (Mitton, Papavassiliou, Puliafito & Trivedi, 2012) (Simmhan et al., 2013). This data will allow them to react to deviations faster and evade interruptions n the logistics procedures. It will also be possible to smartly link information on traffic flow, operations setup and consignment movements and produce vital reports that will offer innovative extra significance details like the projected period of arrival.

So data about all these has to be accessible easily so that they can be analysed for the purpose of making the best decisions out of the data available. The aim is to connect all stakeholders linked to the seaport logistics functions. It will be probable to observe in actual time transportation in and out of the port and the utilisation of infrastructure facilities for port depots as well as to allow the efficiency and safeguarding the transportation of consignments.

2.5.5 Pervasive computing

Pervasive Computing is the ability of inbuilt computer devices to read data, events and activities surrounding them and be able to act on them (Saha & Mukherjee, 2003). It is the embedding of computational capability into everyday objects to enable them to perform their useful tasks in a smart way. This computational capability enables devices to operate, make decision and communicate without human intervention.

With pervasive computing equipment, machines and tools in the ports will be doing operational activities without being controlled by a human being (Garlan, Siewiorek, Smailagic & Steenkiste, 2002). The quayside equipment can offload containers or goods from a ship to the yard and from the yard to trucks or trains without being operated by a human being. The port machinery will also be able to relay information to port operating sytem or employees informing them of where they have placed the containers or the goods.

They get data from the other machines or from the cloud where it is stored and interpret the meaning from the data, then perform the necessary activities, which are required in relation to the data will have been interpreted and analysed (Achten, 2005). Using control station software, the port monitors will draw data from numerous outputs like automated visual aid, container locations, seawater altitudes, wharfs status, traffic channel depths and sizes, building constructions in progress, prearranged road closers and others. The data is obtained from different systems and merged to produce one informative report (Shi, Tao & Voß, 2011).

2.5.6 Information security

Information Security would be an important area, which needs to be managed as there will be a lot of data exchange and sharing between parties in the operational activities. So trustworthiness will have to be established between these parties and information security mechanisms and tools are going to be needed to ensure privacy, confidentiality and integrity is preserved (Jin, Gubbi, Marusic & Palaniswami, 2014). Information security will provide a good platform for the exchange of data and information without it being accessed by the wrong people.

Information and communication technologies (ICTs) is the footing on which intelligent developments are built, either building a new port terminal or converting an old one. These ICTs among others include the internet, radio, CCTV, social networks, fiber optics, GPS, smart phones, tablets, sensors, wireless, NFC, satellites and cloud computing. These ICTs are vulnerable to threats occurring in the cyberspace such as malwares like stuxnet, botnets or denial of information, spoofing in bank accounts or system blackouts. These attacks could jeopardize any intelligent project therefore information security to guard against this is a crucial element to the adoption of an intelligent port terminal (Choo, 2011).

One precise challenge in IoT is monitoring the use of data gathered and dispersed by portable gadgets, which are progressively becoming smaller and ubiquitous like RFID or upcoming micro-nano radars. Individuals are now starting to understand that any determinations they take to guard their own personalities have nearly no impact owing to the quantities of data smart gadgets are amassing and distributing. Numerous gadgets are no longer safeguarded by renowned tools like antiviruses and can be exposed by being connected on an open interconnected network (Rekleitis, Rizomiliotis & Gritzalis, 2011). Gadgets can be embezzled and the information they contain exposed to hackers to reveal confidential information for individuals. Merging information from diverse systems is another key matter as usually there is no trusted connection amongst the suppliers and users of the information.

Some of these new technologies are not difficult to hack, and since the hub of connecting is the smartphone, and the delivery method is your Wi-Fi, securing these two technologies are your first line of defence on the threat landscape. It is forecast that intelligent seaport files will ultimately be warehoused on the cloud-server and utilise cloud computing practices, owing to a greater flexibility of the capacity a person can request at any given point of time with better performance and cheap prices in upkeep and set-up. In this instance, the computer management systems implemented by an intelligent port will also get the danger and confidentiality risks of cloud computer systems (Hashemi, 2013). Furthermore, the intelligent port setup will work together with radars and detectors in order to collect information and regulate dire operational activities. This obviously needs the authentication and authorization of access and to make available a reliable figure in a protected and confidential preservative method.

An intelligent port infrastructure is open to numerous threats such as the hacking of the infrastructure setup controller, corruption of data and leakage of private data. Information security drive is trying to reduce the issues that affect confidentiality, data safety and confidence in the data processed in the intelligent port. Normal network security mechanisms such as firewalls, internal control checks or the usual authorisation checks will not be sufficient to stop such well thought attacks because of the dispersed kind of the IoT and the difficult of outlining reliable stakeholders. It is vital that security is assembled into the setup instead of being implemented as an additional plug-in tool. A real defence tactic is to have an in depth security framework that would prevent data leaks and also address the security threat associated with the diverse technology emanating from IoT (Ziegeldorf, Morchon & Wehrle, 2013).

2.6 Adoption of an intelligent port terminal

Congestion at seaports in Durban and South Africa has been the greatest challenge. Until recently, no attempts had ever been made to fully automate processes resulting in inefficiency and huge delays in the transportation of commodities. Raw materials lose their freshness, and cargo distribution to industries becomes increasingly expensive. As a result, the country is not competitive with the rest of Africa or the rest of the world and its beginning to lose business to new fully automated seaports, which are emerging in nearby countries such as Mozambique, Namibia and Tanzania (Ndlovu, 2007).

South Africa's seaports are 100% government-owned, but they have their own corporate governance and authority to make business decisions as an organization. South African ports have decided to solve their problems the intelligent way, with the long-term goal, of being an intelligent port terminal (Hakam, Solvang & Pieskä, 2014). Firstly, what is required is a core ERP and an automated back office. Only then could other critical elements be added to the roadmap (Antoniadis, Tsiakiris & Tsopogloy, 2015).

But even more important than technology, becoming competitive requires a performance-oriented culture, something that is lacking in the organization. Port terminals have now automated some of its process such as the terminal truck gate entry, time management and payroll functions for their employees along with training and development opportunities.

Equally important is the topic of information security. Port terminals already run a security management system, which will be connected to a system to automate every entrance and departure points for automobiles and commuters. Another future step will be to assist with stack yard control using radars to get complete understanding on the position and transportation of vessels.

Technology is critical from the operational point of view. Analytics will provide clarity in governance and enable risk management. Business networks connecting suppliers is part of the roadmap. Automated finance, procurement, and supply chain management are already increasing efficiency and generating significant increases in revenue. These unprecedented results have been attributed to automation and the new performance-driven culture (Kowalczyk & Buxmann, 2015).

Nowadays, most managers are profoundly mindful that digitalisation can be either a chance or a risk. The issue is not to automate their business operations or not, but in what way to automate business operations by adopting innovative technology and also sustaining a productive business. Most of the senior managers are scared of the challenge of investing in massive IT mechanisms and innovating without unsettling the current business setup. Merely 15% of the top business executives are implementing a digital strategy, although 90% understand that the digital economy will influence their business. As these big business overlook this certainty, early adopters of digitalisation are attaining 9% greater profits returns, 26% better effect on productivity, and 12% other market share appraisal (Kolomitz & Cabellon, 2016).

Most business leaders are unwilling to change the way they do their business and adopt new technology and transform their business because they are comfortable with the current stability and predictability. (Appelbaum, Karelis, Le Henaff & McLaughlin, 2017). Regrettably, the modern business environment is fast and continuously changing at the moment, we are experiencing an upsurge of business internet links, huge data exchange and digital inventions. While this this huge change in internet connectivity and communication is changing the game, clients are profoundly shifting the procedures requesting easy, efficient and reliable tailored practices on every function business provide.

Many businesses are now utilising social and digital platforms to deliver solutions, share perceptions and participate in business. At the same time different means of communicating with clients are formed and better ways of utilising the current resources to increase efficiency and productivity are being created. It is these societies that push organisations to not only give clients what they want, but also bring into line determinations across the business industry to make the most of their potential (Grant, 2016). To grab hold of the breaks into the future, industries must go past radars, big data, analytics, and social media. Most importantly they should reinvent themselves in a mode that is well-suited with the progressively more digitalised business industry and its clients.

2.7 Ports which have adopted the intelligent/smart technology

The list below highlights some of the few harbours that understood the significance of innovation and digitalisation and quickly, adopted the intelligent technology concept and are reaping the rewards.

- Port Amsterdam: - a port that presents a model of "Smart Green Port" based on 3 axes: Environment, Intermodal and ICT (Hollen, van den Bosch & Volberda, 2014).

- Port Hamburg: - has a model of smart port-based on logistics services offered to both foreland and hinterland. Hamburg smart port 2025 project relies heavily on an intelligent ICT infrastructure and logistic services based on them (Ferretti & Schiavone, 2016).

- Port Singapore: - Its business case is the development of the Maritime Intelligence & Shipping (Hollen, van den Bosch & Volberda, 2014).

- Port Barcelona: - Has made a re-interpretation of the services and ICT applications of the last 15 years, and now presents them as a new IT solution that the port authority offers to its port community, to automate its process and add any technology enhanced services (Hein, 2016).

- Port Rotterdam: - Erasmus University and the port of Rotterdam launched the smart port Rotterdam Project in 2010, to connect knowledge management with new logistical services of the port of Rotterdam. (Hollen, van den Bosch & Volberda, 2014).

- Port Kansas: - KC SmartPort promotes and enhances the status of the Kansas City region as a leading logistics centre in USA.

2.8 Theoretical framework

A number of theoretical frameworks have been developed as a result of research on technology adoption. These frameworks consist of various components that are used in order to determine adoption of different technologies. Below is a discussion of the various frameworks that are available.

There are many theories available to study the adoption of a technology (TAM, UTAUT, TPB) (Holden & Karsh, 2010; Esteva-Armida & Rubio-Sanchez, 2012; Dulle & Minishi-Majanja, 2011; Wu & Chen, 2005) but at the firm level two theories are available, which are the Diffusion of Innovation (DOI) Theory and the TOE framework (Ali, Soar & Yong, 2015).

The DOI theory emphasises the rate at, which new technology is first adopted and how it is received by individuals (Chang, 2010) and the rest of the organisation (Yu & Tao, 2009). It states that individuals possess different willingness to adopt a new technology and once a few individuals have adopted it they will influence its adoption by other individuals. The theory divides adopters of technology into innovators, early adopters, early majority, late majority and laggards (Dearing, 2009). The DOI implies that the adoption of new technology in the organisation is influenced by the characteristics of the leaders in the organisation as it drives the willingness of the organisation to adopt new technology. The internal characteristics of the organizational structure also play a part in how technology is embedded into the firm over time. The openness of the organisation or how it interacts with the environment surrounding it, which constitutes the external characteristics also determines how fast an organisation will adopt a new technology.

The TOE theory emphasis on three aspects (Kim, Park, Choi & Min, 2014): -

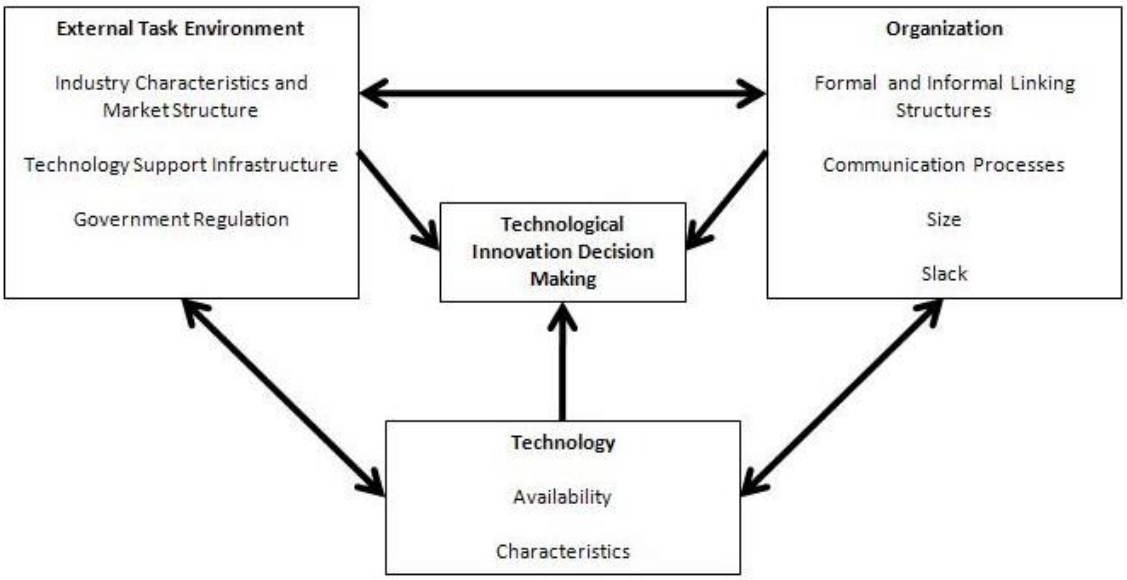
- Technological aspect, which looks at the technology the organisation is currently using in carrying out its operations. It also looks at the technology, which is available for the organisation to utilize in accomplishing its tasks although it has not yet been implemented by the firm. TOE states that factors such as processes, practices and equipment should also be classified under technology.

- Organisational aspect, which looks at how the organisation is structured as it influences how decisions are made and how they are communicated in the organisation. The scope of the organisation is also taken into consideration as it covers the size, goals and aims of the organisation these affect the rate at which change can be effected in the firm.

- The other aspect is the environment in which the organisation operates. Issues to take into consideration are the industry the organisation is operating in as it determines if it is a technology driven industry or if new technology does not effect change into the sector. Competitors also have to be taken into consideration in the environment aspect as no organisation wants to be lagging behind from the new technology, which its competitors are using. The government also plays a huge role in determining the environment in which the organisation operates as it sets rules to regulate operations in an industry of its country.

This study will utilise the TOE theory shown in figure 2.2 as it includes the aspect of the environment (Dedrick, Venkatesh, Stanton, Zheng & Ramnarine-Rieks, 2014), which is not covered by the DOI theory. As the adoption of an intelligent port terminal heavily relies on the environment surrounding it such as the government regulations, technology support infrastructure, industry characteristics and market structure.

TOE Framework diagram



Source: Tornatzky and Fleisher, 1990

Figure 2.2: T.O.E framework

2.9 Hypotheses of the TOE on adoption of an intelligent port

Research on factors influencing the adoption of an intelligent/smart port terminal is still new. For the purposes of this study, a model was considered for analysing issues influencing the adoption of new technology from the literature review of studies such as the adoption of RFID (Li, Liao, Yuan & Yu, 2011). The potential factors investigated in relation to their influence on Intelligent/Smart Port Terminal adoption in Durban are listed in Table 2.2.

Categories	Influencing factors
Challenges and Limitations	Challenges and limitations experienced in port terminal operations
Technological Context	Technology Availability
	Technology Competence(Perceived compatibility)
	Technology complexity (Perceived Complexity/serviceability)
	Data & Information security
	Perceived benefits
Organisational Context	Organisational Structure (Culture & Size)
	Communication process (Organisational Change)
	IT Skills (Adaptability of employees)
	Top management support
	Organisational Goals
Environmental Context	Competitive pressure
	Laws and regulations
	Customer Readiness (Customer systems, processes)
	Trading partners influence (.e.g. Shipping agencies & trucking companies)

Source: - (Author Compiled)

Table 2.2: Factors influencing intelligent port adoption

2.10 Study proposed framework

A diagrammatic representation of the hypotheses is presented in Figure 2.3, accompanied by corresponding hypotheses statements listed as H1 through to H15.

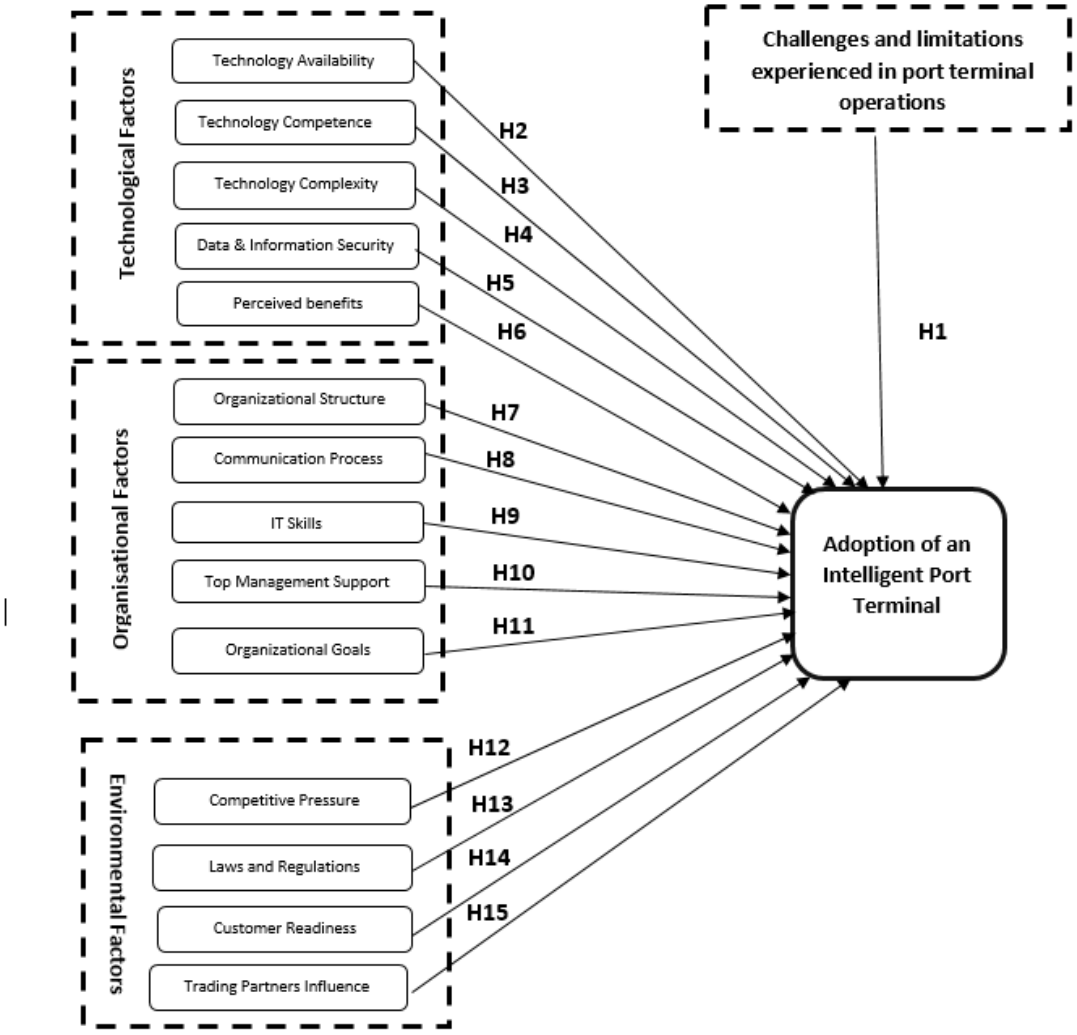


Figure 2.3: The research hypothesis

2.10.1 Challenges and limitations

H1: Current challenges and limitations have an influence on port terminals in Durban adopting an intelligent port terminal.

2.10.2 The technology context

H2: Technology availability has an influence on port terminals in Durban adopting an intelligent port terminal.

H3: Technology Competence has an influence on port terminals in Durban adopting an intelligent port terminal.

H4: Technology Complexity has an influence on port terminals in Durban adopting an intelligent port terminal.

H5: Data and Information Security has an influence on port terminals in Durban adopting an intelligent port terminal.

H6: Perceived Benefits have an influence on port terminals in Durban adopting an intelligent port terminal.

2.10.3 The organization context

H7: Organisational Structure has an influence on port terminals in Durban adopting an intelligent port terminal.

H8: Communication Process has an influence on port terminals in Durban adopting an intelligent port terminal.

H9: IT Skills have an influence on port terminals in Durban adopting an intelligent port terminal.

H10: Top management has an influence on port terminals in Durban adopting an intelligent port terminal.

H11: Organisational Goals have an influence on port terminals in Durban adopting an intelligent port terminal.

2.10.4 The environment context

H12: Competitors pressure has an influence on port terminals in Durban adopting an intelligent port terminal.

H13: Laws and Regulations have an influence on port terminals in Durban adopting an intelligent port terminal.

H14: Customer Readiness has an influence on port terminals in Durban adopting an intelligent port terminal.

H15: Trading Partners Influence has an influence on port terminals in Durban adopting an intelligent port terminal.

2.11 Conclusion

In this chapter, existing literature on port terminals and their current challenges and limitations was explored, together with intelligent port terminals their adoption and their role in increasing productivity in port terminal operations. The components and features of an intelligent port terminal were also discussed. Furthermore, technology adoption theories such as TAM, UTAUT, DOI and TOE were examined in understanding factors affecting the adoption of technology in general and more specifically an intelligent port terminal. Finally reasons of why the TOE theory was chosen over the other theories were stated and a research model of how it will relate to this study was outlined.

CHAPTER 3 : RESEARCH METHODOLOGY

3.1 Introduction

This chapter focuses on describing the methodology used in this study to address the research questions and achieve the research objectives raised in the previous chapters. It further elaborates on the research instrument, the target population, the sampling method, the data analysis process, the validity and the reliability of the data. The reasons for choosing certain techniques is covered under the advantages and disadvantages of each technique explained. The chapter will also provide an insight on the questions offered to respondents and why these type of questions where included in the questionnaire.

3.2 Research methodology

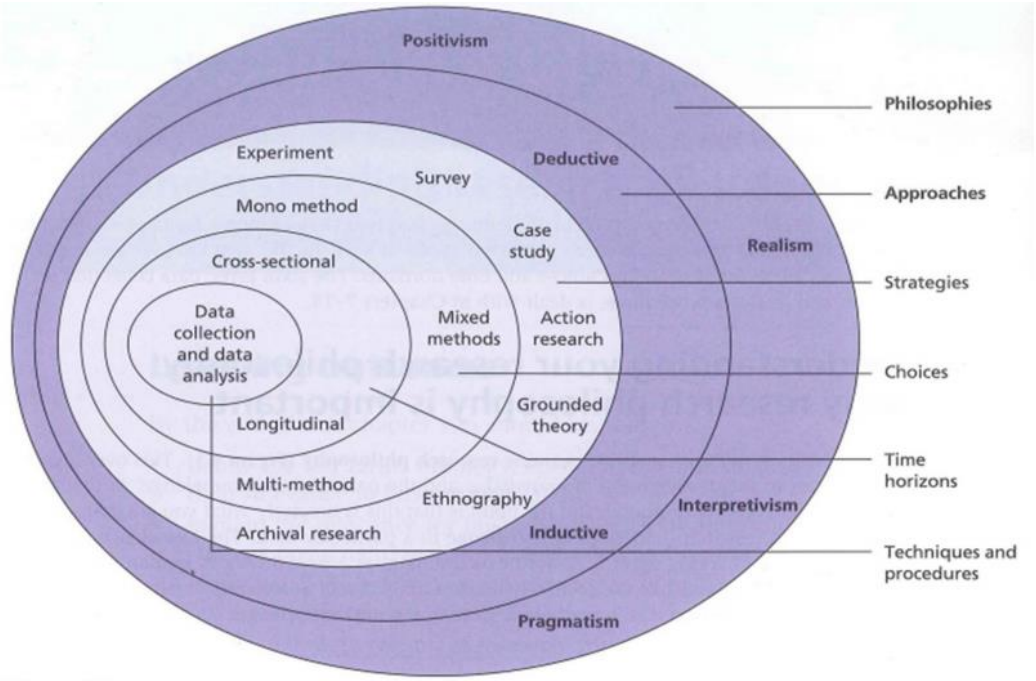
Research methodology is a process, which describes the methods chosen to plan, design and implement the activities of data collection and extraction of meaning from the data whilst carrying out a study (Leedy & Ormond, 2005). Research methodology should be considered as a science and philosophy behind the research (Creswell 2009), which covers a wide-ranging of activities from the early planning of the way data will be collected and analysed until it is reported as illustrated in Figure 3.1.

Source: (Author compiled)

Figure 3.1: Research methodology process

3.2.1 Research onion

The research methodology adopted for the study is best illustrated by a research onion on Figure 3.2. It illustrates the various phases of the process and philosophies of a research on the outer layer there is the data gathering and data examination phases, which are the main principals of the research onion. The research onion portrays a process of doing a research study as an onion with layers having to be peeled off from the outside to the core of the onion while addressing the concern of how data required to answer the research questions will be collected and analysed (Saunders, Wong & Saunders, 2011)



Source: Saunders, Lewis and Thornhill, 2009: p.108

Figure 3.2: The research process 'onion' model

The research onion illustrates four types of research paradigms namely positivism, realism, interpretivist and pragmatism that seem to be significant for any study (Saunders, Wong & Saunders, 2011). "A paradigm is a way of looking at the world. It is composed of certain philosophical assumptions that guide and direct thinking and action" (Mertens, 2005: p.7). Understanding the paradigms aids a researcher to determine appropriate research approaches (Easterby-Smith & Prieto, 2008).

Positivists favour logical measureable approaches, though interpretivist desire humanistic qualitative approaches. Realism depend on the knowledge of freedom of truth from the human cognizance. This viewpoint is founded on the guess of a logical tactic to the growth of information. Pragmatism comprises of persons who claim that an philosophy or intention is correct if its workings are reasonable, that the significance of the intention is to be initiated in the useful significances of tolerating it, and that unreasonable notions are to be excluded (Mustafa, 2011). The positivist paradigm seems to be the most applicable to this study.

3.3 Research philosophy

This is the researcher's view of what constitutes knowledge, which can be used in the research. The understanding of the research philosophy is useful as it aids in clarifying the design process of the study and assists the researcher to identify the best design suited to the study. In addition, the researcher is able to classify and make designs that are outside his or her familiarity (Easterby-Smith & Prieto, 2008)

This study will adopt the positivist paradigm as its purpose is to generate proof, which are straightforward, significantly welcome and free of common ideas (Saunders, Wong & Saunders, 2011; Easterby-Smith & Prieto, 2008; Sobh and Perry, 2006). Positivists usually believe that there is only one truth that can be revealed by means of a measureable and realistic study. Therefore, positivist studies are mostly quantifiable, where facts are gathered and numerical examination is executed on it to also verify or refute the propositions, and normally attempt to check the concept, in order to increase the projected acceptance of a problem.

3.4 Research approach

The research onion illustrates two study methods, the logical that takes a general concept and applies it to a particular situation with the aim of trying to realise a specific outcome. The other approach is the inductive approach, which takes specific information and try to deduce a general theory by making observations, finding patterns and creating a hypothesis and validating it (Johnston, 2014). This study will utilise the deductive approach, which involves working from a known theory and collecting data to confirm or disconfirm this theory.

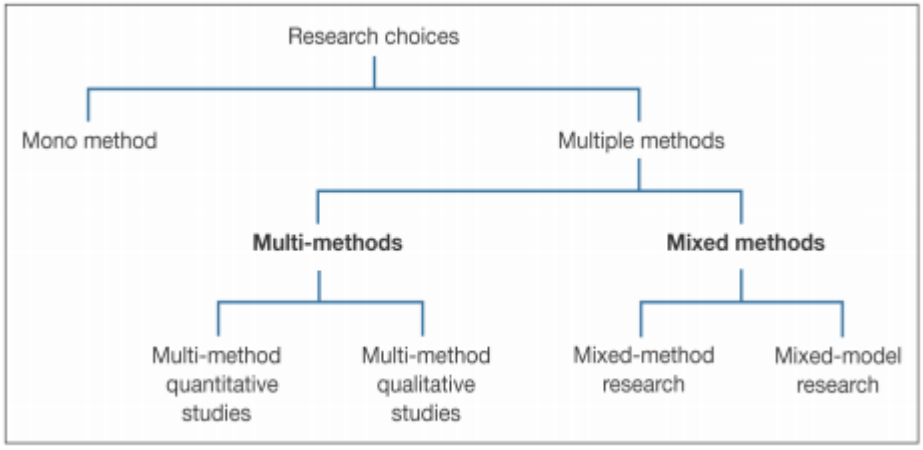
3.5 Research strategy

Research strategy can be well defined as the technique in, which the study aims can be interrogated. Strategies characterize choices and options for the researcher. They encourage, but then again are not in themselves techniques for gathering data. There are eight common types of study approaches in social sciences, namely experiment, survey, archival research, case study, ethnography, action research, grounded theory and narrative inquiry (Saunders, Wong & Saunders, 2011).

For each study, approach consists of its peculiar precise tactic to accumulating and examining experimental data, as well as related benefits and shortcomings. Not any is extra suitable than the other when it comes to research studies. A survey approach was used to collect data in this study, as it is the best approach to gather data in an organised procedure from a considerable amount of participants. A questionnaire survey was carefully designed as a suitable study plan for this research.

3.6 Research method

This layer of a research onion discusses two research choices a researcher faces while scheming a research, whether to use a mono technique or a mixed technique. Figure 3.3 shows a diagrammatic representation of the two research choices and they are further explained below.



Source: Saunders, Lewis and Thornhill, 2009: p.152

Figure 3.3: The research choices

A mono technique study uses a solitary data gathering technique, either a quantitative design (i.e. data gathered by means of a survey form and examined statistically) or qualitative (i.e., data gathered by means of rigorous dialogues and examined as chronicles), while in a multiple methods design the researcher uses more than one data gathering method through the related examination measures. The difference can be made in the numerous techniques amongst multi-method research (various qualitative or quantitative approaches) and mixed methods research (integration of quantitative and qualitative methods) (Creswell & Plano Clark, 2009). This study however will adopt a mono method quantitative design as data will be collected using a questionnaire and examined statistically.

3.6.1 Quantitative vs. Qualitative design

As part of the study design, the researcher is obligated to evaluate whether the study will be that of a quantitative or qualitative nature. This would assist the researcher to focus on shaping the kind of data that is essential to address the intentions of the study. The researcher in this study will use facts and statistics to understand the phenomenon being studied, which therefore leads to the study being one that is quantitative in nature.

Numerical facts speak of research facts that is offered in the form of statistics and figures and is used to respond to enquiries around relations amongst measured variables, in order to advance generalities that add to a philosophy and the data is typically gathered from big sections, in a method that can be transformed to mathematical tables and the data can be gathered in a small period of time (Leedy & Ormond, 2005). A qualitative research usually means that the facts are gathered from a minor sample population and the gathering is time unbearable and the information is naturally used to respond to enquiries about a compound circumstance, with the resolve of providing a detailed and all-inclusive examination of a certain situation from the opinions of the research accomplices (Leedy & Ormond, 2005).

3.7 Time horizon

There are two kinds of time horizons to select when carrying out a study, cross-sectional studies and longitudinal studies. A cross-sectional design is undertaken where a research is done to respond to an enquiry or address a phenomenon at a specific period, so-called a ‘snapshot’ and is probable to make use of plans such as a review or case study (Hodkinson & Macleod, 2010). A longitudinal approach is embarked on wherever a study is carried-out to respond to an enquiry or address phenomenon over a lengthy period of time. Longitudinal designs are probable to create certain use of approaches like an experimentation, action research, grounded theory and archival research (Hong, Chao, Yang & Rosner, 2010). A cross-sectional research design was used owing to time and budget restraints. A longitudinal study methodology was not appropriate as this study is not measuring changes in perceptions over a period of time

3.8 Research setting / study site

This research was based in Durban, the largest city of the province of Kwa-Zulu Natal in South Africa. The port terminals that fell within the scope of the study were as follows:

- Durban container terminal (DCT) which is the largest container terminal in Southern Africa.
- Durban Ro-Ro operation involves the receiving and dispatching motor vehicles from South Africa.
- Maydon Wharf & Agri-Bulk, which handles mostly the dispatching and arrival of agricultural products.

3.8.1 Target population

Population is defined as the total pool of components or individuals in the range being studied by the researcher (Sekaran & Bougie, 2016; Zhao, Tian, Cai, Claggett & Wei, 2013). The population intended for this study is the employees of port terminals in Durban, which consists of the headquarters, Durban container terminal, Durban roll on-roll off and Maydon-wharf. Due to time and financial constraints the researcher decided to limit the research to the vicinity of the city of Durban.

The target population comprised 100 EIMS department staff. They are the employees who are qualified, experienced with technology and are knowledgeable about the adoption of an intelligent port terminal. The employees targeted have a qualification of a Diploma or higher where they have obtained a basic knowledge of business laws and the company also offers workshops and refresher courses on the King Code, Corporate Governance III for compliance purposes. Senior management, middle level employees and IT technicians at head office and at the terminals utilise information technology to enhance their day-to-day operations. These employees are responsible for the running of the ICT Port terminal department and provide input into making decisions on technology adoption to operate the ports.

3.9 Sampling method

A sample is a subsection of the complete populace nominated to partake in a survey (Sekaran & Bougie, 2010, p. 265). Trochim, (2002) defines sampling is the process of selecting units from a population of interest so that by studying the sample and understanding the properties of the characteristics of the sample subjects, the properties may be generalized to the population elements. In this study, participants were selected to form a sample based on their proximity and technological proficiency, as collecting data from an entire population can be very expensive and time-consuming.

Non-probability sampling also called judgemental sampling (Luo, 2010), was utilised to select the suitable participants for this research as specific employees were targeted to assess the relationship between the current challenges and limitations of technology available, organisational structure, operating environment and adoption of an intelligent port terminal. Judgemental sampling enables employees to be selected with a purpose in mind (Knotters & Brus, 2012).

3.9.1 Sample size

In determining the acceptable response rate for this study, Krejcie and Morgan (1970's) table was used. This table (as shown in Appendix D) states that, for a population size of 100, the sample size must be no smaller than 80. There are three operational port terminals and one head office in Durban with a total of 90 EIMS employees. Eighty EIMS employees were selected from the ninety in the EIMS department in Durban. The sample of 80 participants was further broken down as follows, fifty employees were selected from the headquarters and ten from each port terminal with 20% of the employees being part of top management, and 50% were part of middle level management and the remaining 30% from the operational employees. The eighty respondents were purposively selected from the three terminals and head office for them to share their perceptions on the phenomenon.

3.10 Data collection methods

Data can be gathered in a number of diverse methods and from diverse sources. There are diverse gathering approaches, which comprise individual consultations and telephonic discussions. In addition, researchers also use several investigation methods, which comprise mail surveys, e-mail surveys, web surveys and questionnaires (Van Velzen, 2016). The following section elaborates further on questionnaires and deliberates the motives for selecting the questionnaire as the main data gathering technique.

3.10.1 Survey methods

Surveys are one technique of facts gathering, which can be completed swiftly in order to gain understanding into the populace's requirements and perceptions. The benefit of a survey is that it allows the researcher to gather facts from either a huge or lesser populace. "Different types of surveys are actually composed of several research techniques, developed by a variety of disciplines" (Trochim 2002) cited in (Leedy & Ormrod, 2005). In order to choose a survey tool there are numerous aspects to contemplate as well as dependability, legitimacy, sovereignty from prejudice, budget, political concerns and period.

3.10.2 Questionnaires

A questionnaire is a pre-formulated inscribed agreed set of demands to, which respondents record their replies, typically in fairly carefully defined options (Leedy & Ormrod, 2005). A set of participants are selected to answer back to the questions postured in the survey form. Survey forms, as equated to consultations, are greatly appropriate and effective. Producing a well-documented questionnaire is occasionally more challenging than it looks. Cautious deliberation has to be taken to contemplate the nature, content, phrasing, and direction of the questions that they include.

3.10.2.1 Advantages of questionnaires

The information gathered from the closed ended questions in the questionnaire are easy to analyse through software such as SPSS and Microsoft excel. One more significant benefit is that surveys lessen partiality. There is furthermore unvarying enquiry exhibition and no middleman favouritism. The researchers own feelings will not impact the participant to reply interrogations in a certain way. There are no spoken or graphic clues to impact the participant. Questionnaires are also less disturbing as likened to phone or individual consultations. With a questionnaire the participant is permitted to finish the survey in his private permitted period. Unlike other study approaches, this study tool does not disturb the participant. Questionnaires similarly assist the researcher to decide exactly what evidence is desirable (Leedy & Ormrod, 2005).

3.10.2.2 Disadvantages of questionnaires

A unique important drawback of questionnaires is the low response rate that a researcher might perhaps come across. Taking a low reply rate is not ideal for effective arithmetical studies. It might subordinate the researcher's assurance in the outcomes. Questionnaires similarly bid identical slight elasticity once it approaches to the replies of the tool. Though, by permitting space for remarks the researcher would be gifted to gain vital evidence that would have remained or else misplaced, in that way incapacitating this weakness (Leedy & Ormrod, 2005).

3.10.2.3 Construction of the questionnaire

When creating the questionnaire, there are numerous issues, which want to be taken into consideration. Leedy and Ormrod, (2005) highlights that by succeeding procedures for drafting a questionnaire it will inspire contributors to be willing and produce answers that the researcher can use and understand. The procedures comprise the next items:

- Have it short; use modest, pure, unmistakeable language,
- Check for unnecessary expectations contained in your requests,
- Word your requests in means that do not provide traces about anticipated outcomes,
- Deliver pure guidelines providing a justification for any articles whose determination might be uncertain,
- Inspect the practically finished creation cautiously to ensure it satisfies your requirements.

3.10.2.4 Structure of the questionnaire

The questionnaire (as shown in Appendix C) consisted of the following six segments, designed to collect data to answer the four (4) research questions listed in section 1.2.1:

Section A: - Demographics.

Section B: - Technological factors.

Section C: - Organisational factors.

Section D: - Environmental factors.

Section E: - Adoption of an intelligent port.

Section F: - Challenges and limitations in port operations.

The questionnaire consisted of a Likert-scale for all the sections, except the demographics section (Section A), because a measurable value was allocated for each possible select. For each statement in sections (B, C, D, E and F), participants were requested to rate the statement on a five-point Likert evaluation gauge ranging from 'Strongly Agree' (5) to 'Strongly Disagree' (1), Participants were requested to tick the appropriate boxes. The closed ended questions contained in the questionnaire were designed to identify factors influencing the adoption of port terminals in Durban.

3.11 Reliability and validity test

The questionnaire for this survey went through a reliability and validity check process, in order to guarantee that the facts gathered using this questionnaire is dependable, error-free and valid. Reliability is a check of dependability taking a gauging tool to quantify whatsoever idea it is assessing and validity is a check of how a tool is developed in assessing a certain model it is envisioned to quantify (Sekaran & Bougie, 2016).

Reliability refers to the consistency of a test (survey tool). A test is dependable or unswerving if the tool can harvest related outcomes if used once more in comparable situations. The data collected through questionnaire was analysed by a statistician (Appendix G) using the statistical software called Statistical Package for the Social Sciences (SPSS) 22, It is a software package used to statistically analyse results of data collected. In ensuring that the data collected is of good quality, consistent, and reliable, the data collected via the questionnaire underwent the reliability test. The dependability of the constructs was tested by Cronbach's coefficient alpha. According to George & Mallery (2013), coefficient alpha is the measure of internal consistency ensuring that all items within a section measure the same thing.

Validity speak of whether a study tests what it is supposed to quantify (Lameck, 2013), Experts who understand my topic reviewed the questionnaire and a pilot study was done to measure the legitimacy of the research tool. The validity had to identify any possible risks that could threaten or jeopardize the research project as well as to ensure that the proposed questionnaires or language or methods used were appropriate and not complicated. The experts evaluated whether the questions effectively capture the topic under investigation and a trial study of the review instrument was passed out to five employees in the port terminals EIMS department. These employees were at different levels in the organisations structure and included technical, middle and senior management employees. After the pilot study, the questionnaire went through changes to improve its quality and presentation.

3.12 Administration of the tool

All the prospective participants were invited using the email and the google forms survey, in order to allow the researcher to benefit from reaching a substantial number of subjects. This enabled easier administration of the questionnaire, the obtaining of speedy responses and participants to answer at their own convenience. However, challenges faced with this data-collection method were unwillingness of participants to complete the questionnaire or not having time to contribute.

On the 18th of October 2016, an electronic mail (e-mail) with the individual consent form and the research questionnaire was sent to the eighty employees who were nominated to partake in the study. Some employees requested to complete the questionnaire on a physical paper as it was easier for them and also felt responding on email will be traceable back to them.

An electronic survey (e-survey) was developed on google forms, which is a free online survey offered to Gmail account clients. On the 9th of November I sent through email the link to the e-survey to all employees who had not responded to the email survey or on the printed questionnaire. Two reminders were sent later at intervals of a weeks apart.

Six weeks after the questionnaire was administered, the daily response rate reached zero, the sample consisted of eighty (n=80) employees in the EIMS department, who were requested to take part. Conferring to the entire sample size of the study, 80 questionnaires were distributed and a total of 55 (n=55) were effectively answered, meaning the study attained a 69% fruitful reply ratio. However, the issue of adequate response rate has created mixed reactions amongst researchers. Acceptable response rates were reported as follows: 50% (Babbie, 1990; Babbie & Mouton, 1998), 60% (Kiess & Bloomquist, 1985) and 70% (Dillman, Christenson, Carpenter, & Brooks, 1974).

3.13 Data analysis

The following data analysis tests were performed using the quantitative data, namely descriptive statistics (frequency distributions, mean and standard deviation), Wilcoxon Signed Ranks test, Regression analysis and the one sample *t*-test. The purpose of these tests is as follows:

- Descriptive statistics including means and normal abnormalities, were applied. Frequencies were represented in tables or graphs.
- Wilcoxon Signed Ranks test: A non-parametric test used to test, in this study, whether the average value is significantly different from a value of 3 (the central score). This was applied to Likert scale questions. It was also used in the comparison of the distributions of two variables.
- Regression analysis: Linear Regression estimates the coefficients of the linear equation, involving one or more independent variables that best predict the value of the dependent variable.
- The one sample *t*-test: Tests whether a mean score is significantly different from a scalar value.

3.14 Ethical Issues

In this study respondents were well informed and educated about the study in advance after which consent was sought with respondents being given the option to decide whether they want to participate in the study or not. Their right to privacy, confidentiality and anonymity was also respected as the identities of respondents would not be sought or revealed. A gate keeper's permission was obtained from port terminals management, which was submitted to the ethics research committee (ERC) of the KwaZulu-Natal University so that an ethical clearance (Appendix A) could be obtained to be able to carry out the study.

3.15 Conclusion

This chapter discussed the methodology applied in this study, which covered the research strategy outlining the plan for information gathering, as well as methods used for selecting the sample. A self-administered survey tool with both open and closed ended enquiries was established as the tool for data gathering. Thereafter, the questionnaire underwent testing for reliability and validity so as to identify out-of-range cases, ensuring that the facts collected is reliable, error free, and valid. The following data-analysis tests were identified in this chapter: Descriptive statistics (frequency distributions, mean and standard deviation) of responses, Wilcoxon Signed Ranks test, Regression analysis and the one sample *t*-test. The next chapter will present the results obtained from conducting the study.

CHAPTER 4 : PRESENTATION OF FINDINGS AND INTERPRETATION

4.1 Introduction

The purpose of this chapter is to present and interpret the outcomes acquired from the analysis of the data collected by questionnaire administered for this study. The analytical tests presented in this chapter include the reliability and validity test, descriptive statistics namely frequency distributions, mean and standard deviation and inferential statistics namely Wilcoxon signed ranks test, regression analysis, and the one sample *t*-test.

4.2 Reliability test results

The questionnaire for this survey went through a reliability test process, in order to guarantee that data gathered using this questionnaire is dependable, error-free and valid. Table 4.1 represents the reliability tests results comprising the construct, number of things used to quantify each of the hypotheses, and Cronbach's alpha. As discussed in the previous chapter (Section 3.11), the Cronbach's alpha was used to ensure that the items form a reliable measure on each section of the questionnaire, except section one on demographics.

Where the Cronbach alpha coefficient is below 0.5, the internal consistency is unacceptable ($\alpha < 0.5$ = unacceptable), where the Cronbach Alpha coefficient is between 0.5 and 0.6, the internal consistency is poor ($\alpha > 0.5$ – poor), where the Cronbach Alpha coefficient is between 0.6 and 0.7, the internal consistency is questionable ($\alpha > 0.6$ – questionable), where the Cronbach Alpha coefficient is between 0.7 and 0.8, the internal consistency is acceptable ($\alpha > 0.7$ – acceptable), Where the Cronbach Alpha coefficient is greater than 0.8 the internal consistency is good ($\alpha > 0.8$ – good) and where the Cronbach Alpha coefficient is greater than 0.9, the internal consistency is regarded as excellent ($\alpha > 0.9$ – regarded as excellent) (Tavakol & Dennick, 2011).

As mentioned in section 3.10.2.4, the survey tool comprised of six segments, each segment representing a construct (technological factors, organisation factors environmental factors, adoption of an intelligent port then challenges and limitations in port operations) except section one, which represented the demographics. The dependability checks were shown for all constructs, and the Cronbach's alpha for 16 items for these constructs suggested that all constructs surpass the acceptable $\alpha > 0.7$, the constructs' coefficient alpha fell between .786 and .951, representing acceptable internal reliability. The lowest Cronbach's alpha being challenges and limitations experienced in port terminal operations, and the highest being competitive pressure as depicted in Table 4.1.

Reliability test results

No.	Construct	No. of Items	Cronbach's Alpha
CHALLENGES AND LIMITATIONS			
1	Challenges and limitations experienced in port terminal operations	7	.786
TECHNOLOGICAL FACTORS			
2	Technological Availability	6	.825
3	Technology Competence(Perceived compatibility)	4	.845
4	Technology complexity (Perceived Complexity/serviceability)	4	.854
5	Data & Information security	3	.907
6	Perceived benefits	5	.930
ORGANISATIONAL FACTORS			
7	Organisational Structure (Culture & Size)	4	.831
8	Communication process (Organisational Change)	3	.845
9	IT Skills (Adaptability of employees)	6	.946
10	Top management support	5	.908
11	Organisational Goals	4	.857
ENVIRONMENTAL FACTORS			
12	Competitive pressure	4	.951
13	Laws and regulations	6	.943
14	Customer Readiness (Customer systems, processes)	4	.863
15	Trading partners influence (.e.g. Shipping agencies & trucking companies)	4	.887
ADOPTION			
16	Adoption of an intelligent port	3	.864

Table 4.1: Reliability test results

4.3 Descriptive statistics

This segment brings graphic figures used to describe patterns and trends of the employees who participated in this study. The descriptive statistics can present data either numerically (such as means and standard deviation) or via frequencies presented in tables and/or graphs. The demographic information was used to provide a summary in graphical form of the profiles of the employees who participated in this study. Section 1 of the questionnaire contained demographics information, which was used to examine whether the demographics of the participants has an influence on the adoption of an intelligent port terminal. The following demographic data was collected on the following items of the participant: age, department, position, highest qualification, working experience and port operations experience.

4.3.1 Age

Table 4.2 represents the age distribution of the respondents. Most respondents were amongst 30- 39 years of age (46%); followed by those amongst 40-49 years of age (29%); with 14% respondents being amongst 25-29; 7% being respondents aged under 25 years and those above 49 years being 4%. Figure 4.1 shows a visual depiction of the age distribution.

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<25	4	7.1	7.1	7.1
	25-29	8	14.3	14.3	21.4
	30-39	26	46.4	46.4	67.9
	40-49	16	28.6	28.6	96.4
	>49	2	3.6	3.6	100.0
	Total	56	100.0	100.0	

Table 4.2: Age [Frequency]

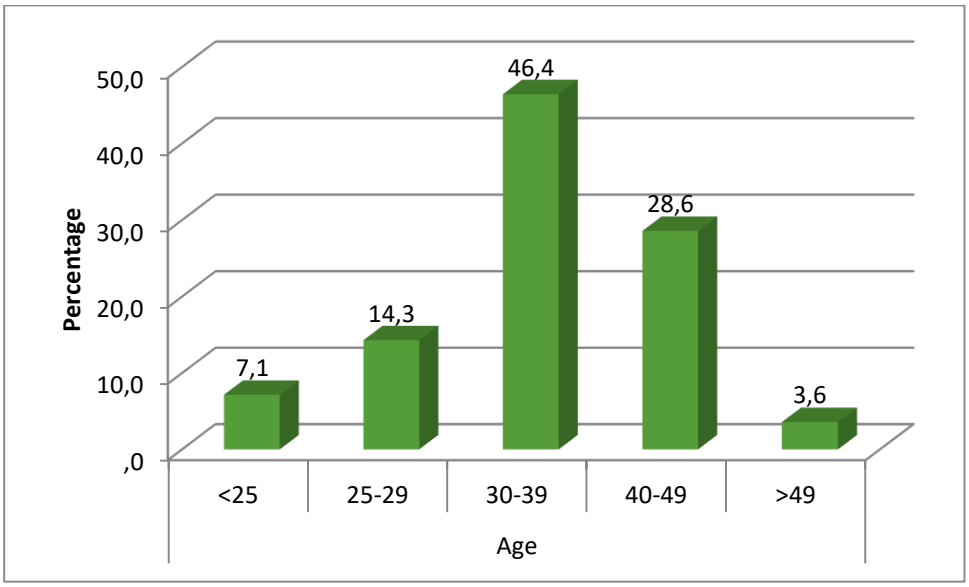


Figure 4.1: Age

4.3.2 Sections in ICT department

Table 4.3 represents the section in which the participants belong to in the ICT department. From the table 4.3 it can be seen that, 57% of the respondents belong to the service delivery team, 20% from the business enablement team, 16% from the office of the CIO team, 5% from the value creation team and 2% from sustainability team. Figure 4.2 shows a visual depiction of the sections distribution. The Service Delivery section has the most employees in the ICT department as it supports the company systems (Navis, SAP & GCOS) and infrastructure.

Sections in ICT department

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Service delivery	32	57.1	57.1	57.1
	Office of the CIO	9	16.1	16.1	73.2
	Business enablement	11	19.6	19.6	92.9
	Value creation	3	5.4	5.4	98.2
	Sustainability	1	1.8	1.8	100.0
	Total	56	100.0	100.0	

Table 4.3: Sections in ICT department [Frequency]

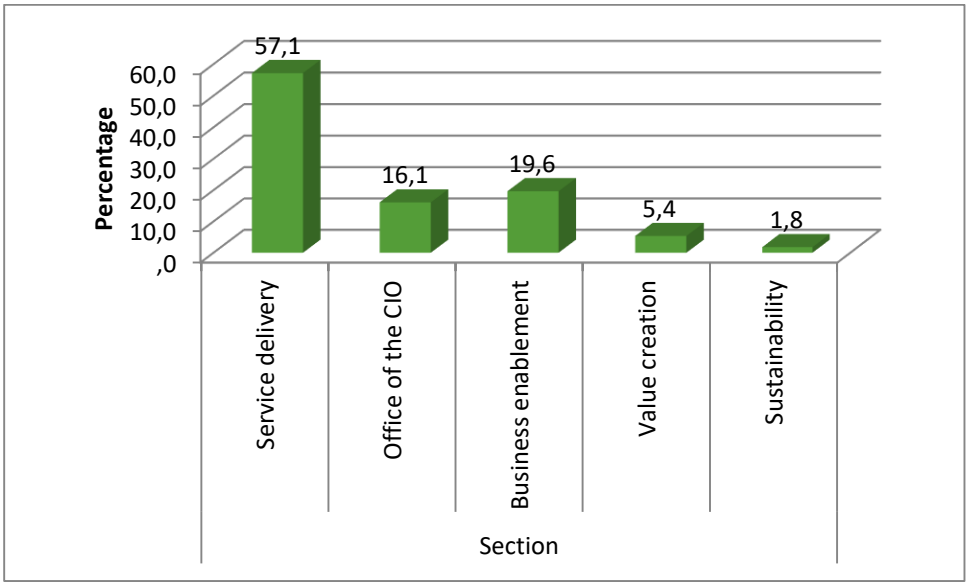


Figure 4.2: Section in ICT department

4.3.3 Position

Table 4.4 shows the positions of people who participated in the survey. Most of the employees who responded in the junior manager level made up 39% of the respondents, the junior level employees and the middle managers contributed a 29% representation each and senior managers had a 4% representation. Figure 4.3 shows the graphical representation of the position of employees who responded.

Position

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Junior level	16	28.6	28.6	28.6
	Junior manager	22	39.3	39.3	67.9
	Middle manager	16	28.6	28.6	96.4
	Senior manager	2	3.6	3.6	100.0
	Total	56	100.0	100.0	

Table 4.4: Position [Frequency]

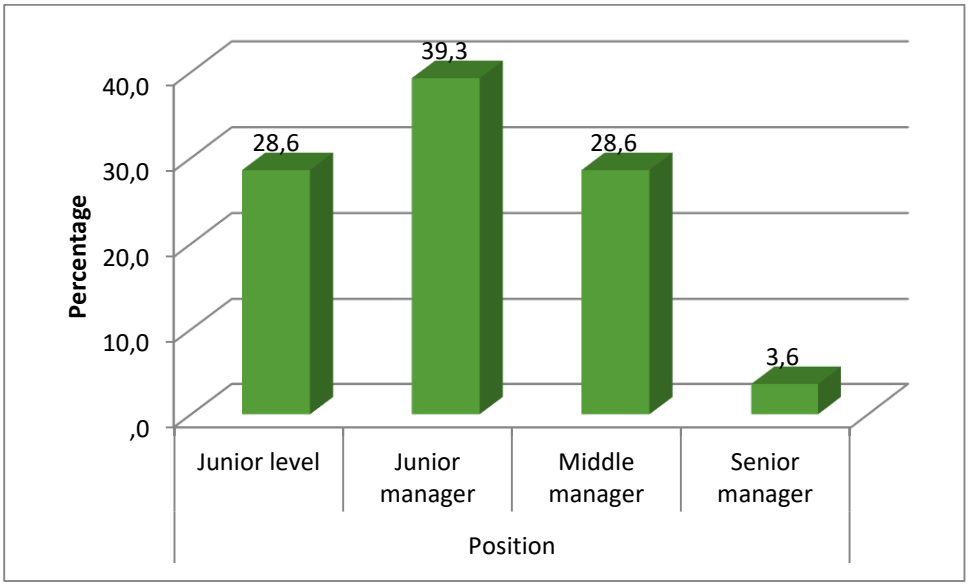


Figure 4.3: Position

4.3.4 Qualification

Table 4.5 shows the highest qualifications of the respondents, most of them have a degree, which is a 34% representation, 30% of the respondents have a diploma, 14% have an honours degree, master's degree respondents had a 11% representation, with 9% of respondents having matric and 2% of respondents having a doctorate. Figure 4.4 shows a graphical representation of the qualifications of the respondents.

Qualification

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Matric	5	8.9	8.9	8.9
	Diploma	17	30.4	30.4	39.3
	Degree	19	33.9	33.9	73.2
	Honours	8	14.3	14.3	87.5
	Masters	6	10.7	10.7	98.2
	Doctorate	1	1.8	1.8	100.0
	Total	56	100.0	100.0	

Table 4.5 : Qualification [frequency]

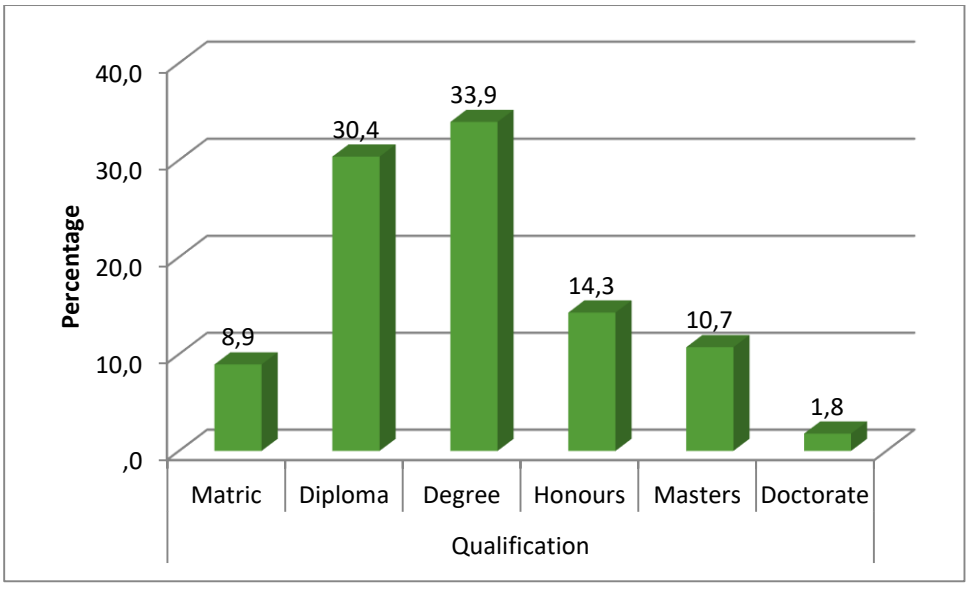


Figure 4.4: Qualification

4.3.5 ICT_experience

Table 4.6 shows the experience of respondents in the field of ICT. The most number of people with ICT_experience is 27% and these are two groups, those with 5-9years and 10-14 years; followed by those who got 1-4 years with a representation of 13%; then those who have more than 20+ years' experience in ICT with a representation of 7%; and 5% have less than a year (<1) ICT_Experience. Figure 4.5 shows a graphical representation of the respondent's experience in ICT.

ICT_experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<1 year	3	5.4	5.4	5.4
	1-4 years	7	12.5	12.5	17.9
	5-9 years	15	26.8	26.8	44.6
	10-14 years	15	26.8	26.8	71.4
	15-19 years	12	21.4	21.4	92.9
	20+ years	4	7.1	7.1	100.0
	Total	56	100.0	100.0	

Table 4.6: ICT_experience [frequency]

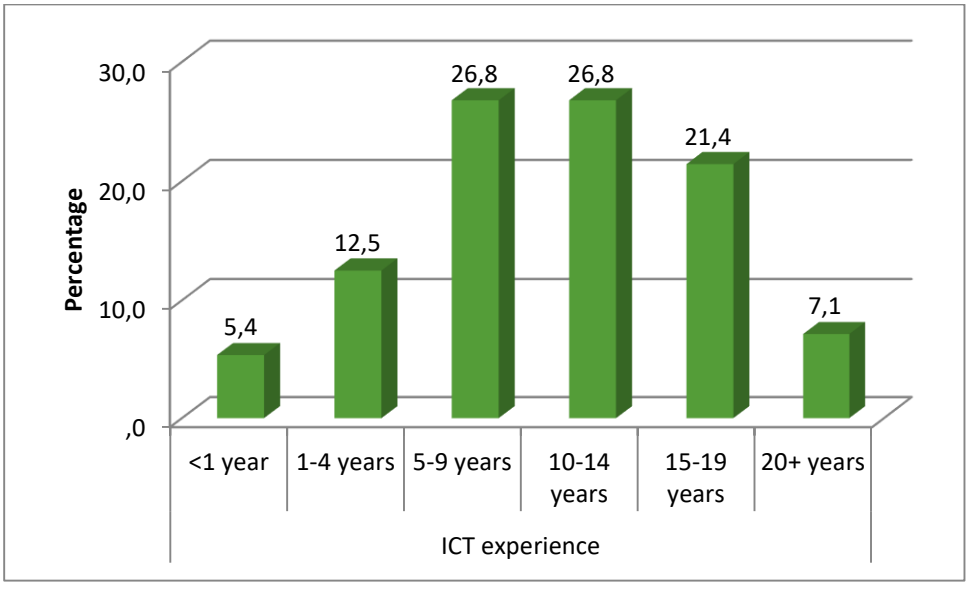


Figure 4.5: ICT_experience

4.3.6 Port experience

Table 4.7 shows the experience that respondents have in working in the port terminal environment. Most respondents have between 1-4years experience constituting a 43% representation; followed by 27% of respondents who have 5-9years port working experience; those having worked less than a year represent 11%; respondents with 10-years and 15-19years represent 7% of the total respondents; and 5% of the respondents have more than twenty years' experience. Figure 4.6 shows a graphical representation of the respondents working experience in the port environment.

Port_experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<1 year	6	10.7	10.7	10.7
	1-4 years	24	42.9	42.9	53.6
	5-9 years	15	26.8	26.8	80.4
	10-14 years	4	7.1	7.1	87.5
	15-19 years	4	7.1	7.1	94.6
	20+ years	3	5.4	5.4	100.0
	Total	56	100.0	100.0	

Table 4.7: Port_experience [frequency]

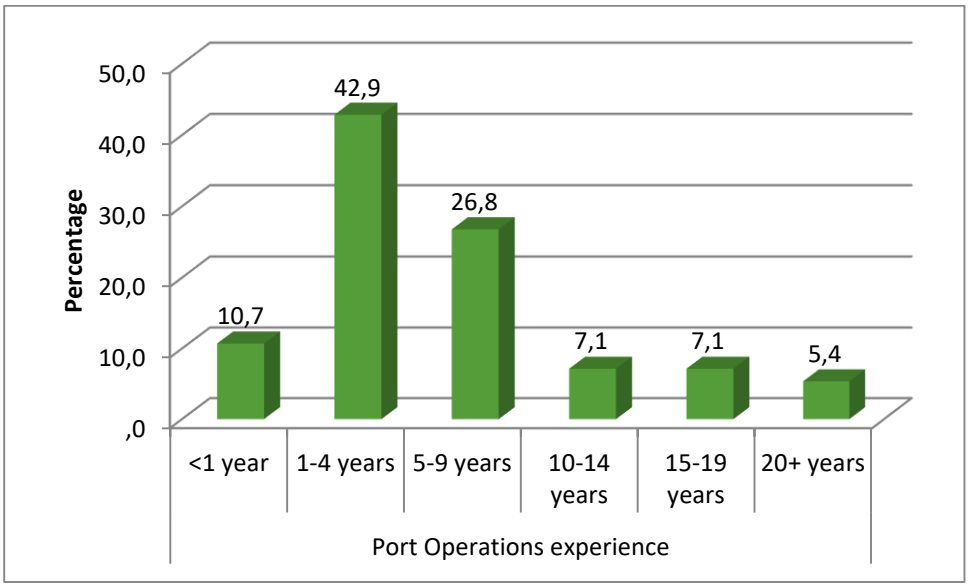


Figure 4.6: Port_experience

4.4 Interpretation of Wilcoxon Signed Ranks test

The Wilcoxon Signed Ranks test was used to establish whether the averages were expressively dissimilar from a neutral value of 3 and also to discover whether the participants were significantly in agreement or disagreement with the statement. This test was applied to Likert scale questions; it was also used in the evaluation of the allocations of the two variables namely significantly in agreement or disagreement. (Derrac, García, Molina & Herrera, 2011).

For each of the predictors in this study listed in Table 4.8 a non-parametric check was used to test whether the normal value was expressively dissimilar from a value of 3 (the central score). Only items with a mean greater or lower than 3 were reported, as they were significant.

Wilcoxon signed ranks test results

Number	Influencing factors	Result
1	Challenges and limitations in port terminal operations	Significant
2	Technology availability	Significant
3	Technology competence	Significant
4	Technology complexity	Significant
5	Data and information security	Significant
6	Perceived benefits	Significant
7	Organisational structure	Neutral
8	Communication methods	Significant
9	IT skills	Significant
10	Top management support	Neutral
11	Organisational goals	Neutral
12	Competitive advantage	Significant
13	Laws and regulations	Significant
14	Customer readiness	Significant
15	Trading partners influence	Significant
16	Adoption of an intelligent port	Significant

Table 4.8 Wilcoxon signed ranks test results

4.4.1 Challenges and Limitations

The Wilcoxon Signed Ranks test disclosed that there is significant agreement with two and significant disagreement with one of the challenges and limitations statements. There was significant agreement on the following statements measuring challenges and limitations:

- There is significant agreement that computer systems (SAP, GCOS & Navis) for port terminal operations are adequate (M=3.79, SD = .868), t (55) = 6.775, p=.000);
- There is significant agreement that IT employees are skilled enough to run port terminal operations efficiently (M=3.41, SD = .910), t (55) = 3.377, p=.001);

There was significant disagreement on the following statement measuring challenges and limitations:

- Labour (Labour unions and employee committees) are in support of fully automating port operations. (M=2.46, SD = .914), t (55) = -4.387, p=.000).

Figure 4.7 shows a graphical representation of the challenges and limitations predictor.

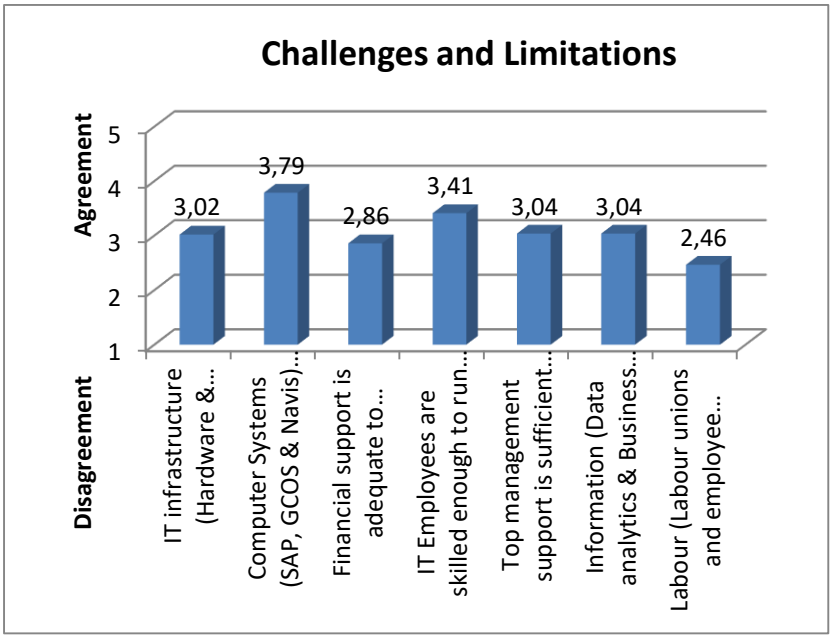


Figure 4.7: Challenges and limitations

4.4.2 Technology Availability

The Wilcoxon Signed Ranks test disclosed that there is significant disagreement on all technology availability statements. There was significant disagreement on the following statements measuring technology availability:

- The necessary internet to fully automate port terminal operations is already available with the mean (M = 2.64) below the average (3), the standard deviation (SD = 1.086), t (55) = -2.461, p=.017;
- Big data (Data analytics tools) to fully automate port terminal operations are already available in the organization (M = 2.46, SD = 1.128), t (55) = -3.555, p=.001;
- Data visualisation (Business Intelligence) tools to fully automate port terminal operations are already available in the organization (M = 2.71, SD = 1.022), t (55) = -2.092, p=.041;
- Cloud Computing capabilities to fully automate port terminal operations are already available to the organization (M = 2.45, SD = 1.190), t (55) = -3.482, p=.001;
- Pervasive computing to fully automate terminal operations is already available (M=2.48, SD = .894), t (55) = -4.334, p<.0005).

Figure 4.8 shows a graphical representation of technology availability predictor.

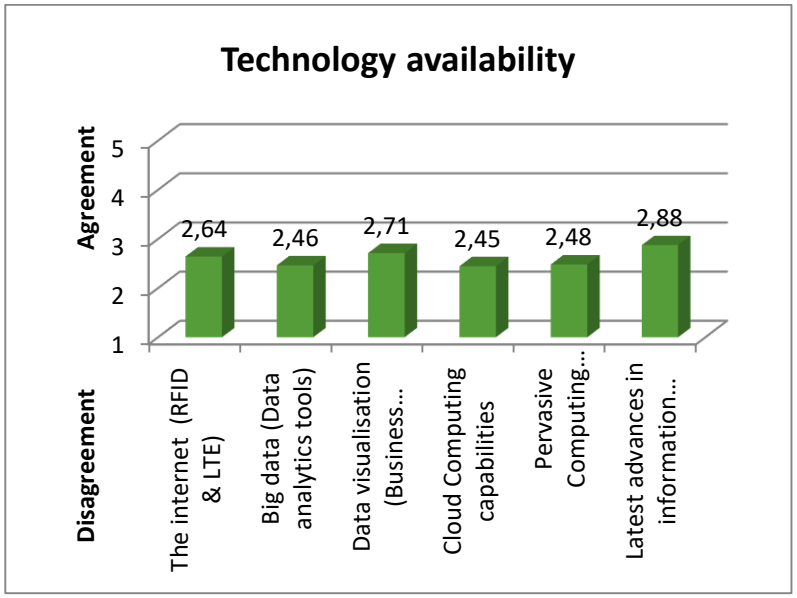


Figure 4.8: Technology availability

4.4.3 Technology Competence

The Wilcoxon Signed Ranks test disclosed that there is significant agreement on half of technology competence statements. There was significant agreement on the following statements measuring technology competence:

- The computer systems (SAP, GCOS & NAVIS) being utilized by the organization are compatible to use for entirely automating the port operations. (M = 3.48, SD = 1.095), t (55) = 3.294, p=.002;
- The technology (Computer hardware, Network's & Systems) in use is well integrated to enable the entire automation of port operations (M =3.36, SD = 1.103), t (55) = 2.424, p=.019.

Figure 4.9 shows a graphical representation of technology competence predictor.

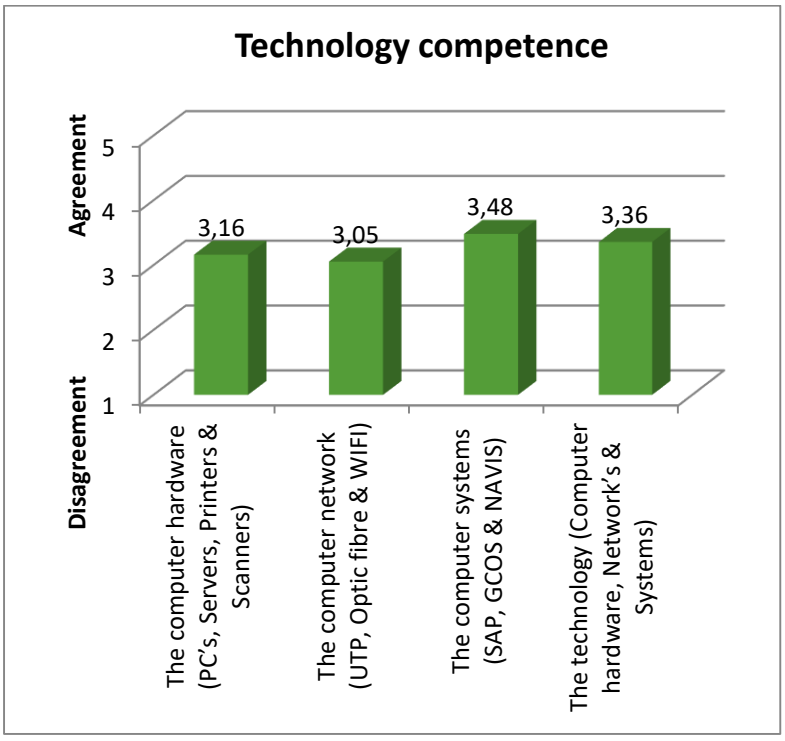


Figure 4.9: Technology competence

4.4.4 Technology Complexity

The Wilcoxon Signed Ranks test disclosed that there is significant agreement on all technology complexity statements. There was significant agreement on the following statements measuring technology complexity:

- The technology being utilised by the organisation is easy and simple to use (M = 3.71, SD = 1.039), t (55) = 5.142, p=.000;
- The technology being used by the organisation is easy to implement (M = 3.25, SD = .899), t (55) = 2.080, p=.042; The technology being used by the organisation is easy to maintain (M = 3.54, SD = .785), t (55) = 5.104, p=.000;
- The technology being used by the organisation can be easily integrated with other computer systems (e.g. from Traffic department, Shipping agents and weather monitoring companies) (M = 3.34, SD = 1.066), t (55) = 2.381, p=.021.

Figure 4.10 shows a graphical representation of technology complexity predictor.

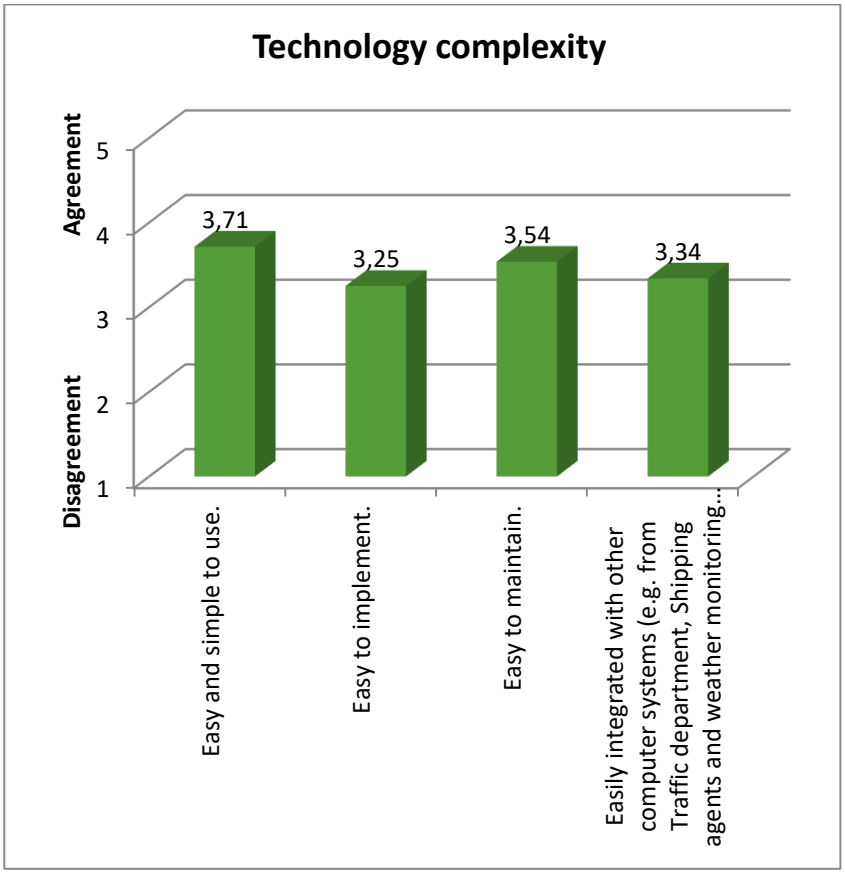


Figure 4.10: Technology complexity

4.4.5 Data and Information Security Capabilities

The Wilcoxon Signed Ranks test disclosed that there is significant agreement on all data and information security capabilities statements. There was significant agreement on the following statements measuring data and information security capabilities:

- The company's data and information security mechanisms are capable of preventing any unauthorised computer system access (M = 3.73, SD = .924), t (55) = 5.928, p=.000;
- The company's data and information security mechanisms are capable of preserving privacy of the company's records (M = 3.68, SD = .834), t (55) = 6.092, p=.000;
- The company's data and information security mechanisms are capable of preserving integrity of the company's records (M=3.71, SD =. 731), t (55) = 7.307, p=.000).

Figure 4.11 shows a graphical representation of data and information security capabilities predictor.

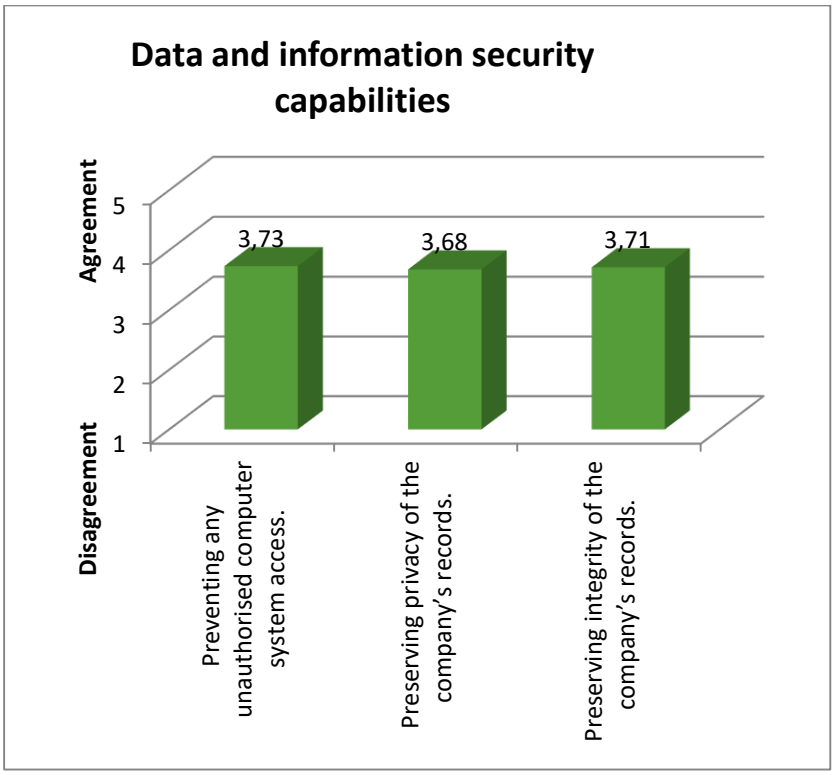


Figure 4.11: Data and information security capabilities

4.4.6 Perceived Benefits

The Wilcoxon Signed Ranks test disclosed that there is significant agreement on all perceived benefits statements. There was significant agreement on the following statements measuring perceived benefits:

- The technology being utilised by the organisation is able to achieve the required operational efficiency (M = 3.48, SD = 1.027), t (55) = 3.514, p=.001;
- The technology being utilised by the organisation is able to achieve the required service quality and consistency (M = 3.54, SD = .953), t (55) = 4.208, p=.000;
- The technology being utilised by the organisation is able to achieve the required operational turnaround times (M=3.48, SD = .953), t (55) = 3.785, p=.000);
- The technology being utilised by the organisation is able to achieve the required operational costs (M=3.55, SD = .872), t (55) = 4.750, p=.000);
- The technology being utilised by the organisation is able to achieve the required operational audit trails (accountability) (M=3.86, SD = .883), t (55) = 7.266, p=.000).

Figure 4.12 shows a graphical representation of the perceived benefits predictor.

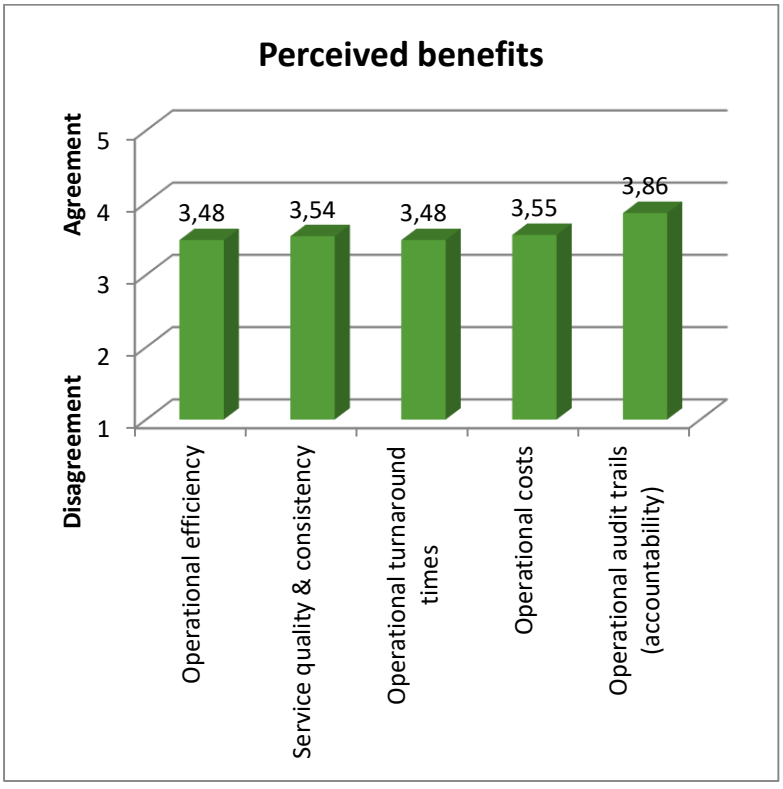


Figure 4.12: Perceived benefits

4.4.7 Communication Methods

The Wilcoxon Signed Ranks test disclosed that there is significant agreement with one of the three communication process statements. There was significant agreement on the following statement measuring communication methods:

- The communication methods/tools (email & meetings, etc.) are effective for running IT operations in the organisation (M=3.48, SD = 1.079), t (55) = 3.345, p=.001).

Figure 4.13 shows a graphical representation of the communication process predictor.

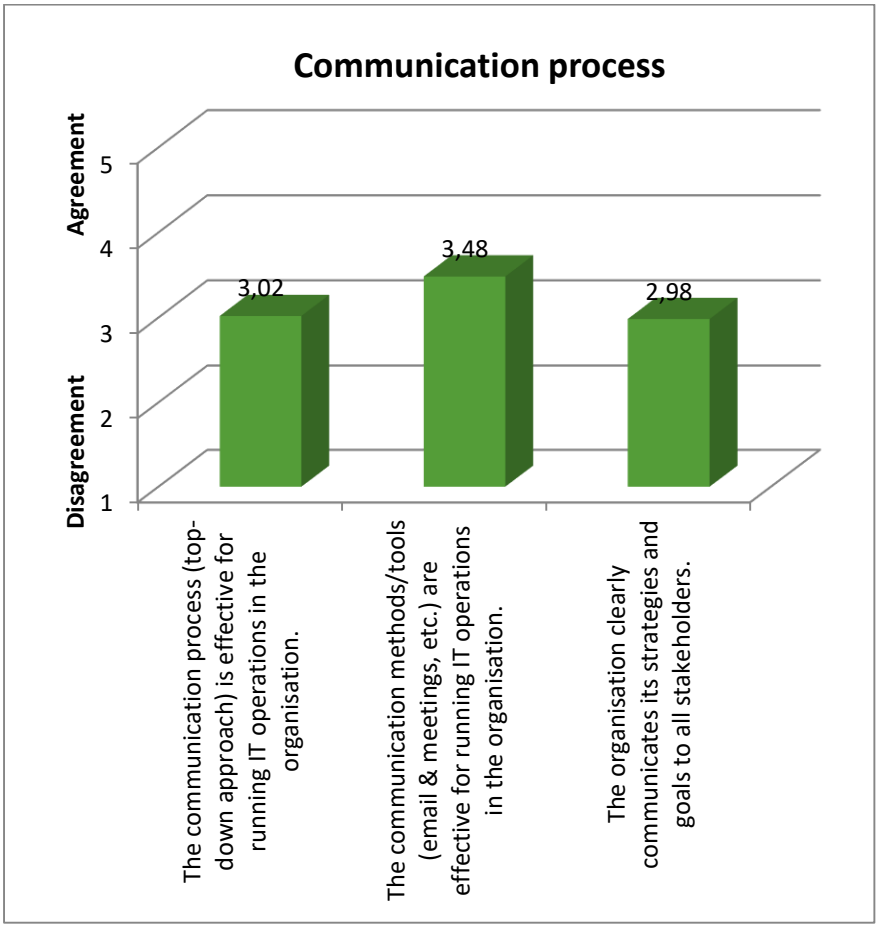


Figure 4.13: Communication process

4.4.8 IT Skills

The Wilcoxon Signed Ranks test disclosed that there is significant agreement with three of the six IT skills statements. There was significant agreement on the following statements measuring IT skills:

- The organisation employees have the technical skills (Programming, Database management, etc.) required to implement IT Solutions (M=3.32, SD = 1.177), t (55) = 2.043, p=.046);
- The organisation employees have the technical skills (Programming, Database management, etc.) required to maintain IT Solutions (M=3.46, SD = 1.095), t (55) = 3.173, p=.002);
- The organisation employees have the decision making skills (intuition, reasoning, etc.) required to maintain IT Solutions (M=3.30, SD = 1.077), t (55) = 2.109, p=.040).

Figure 4.14 shows a graphical representation of the IT skills predictor.

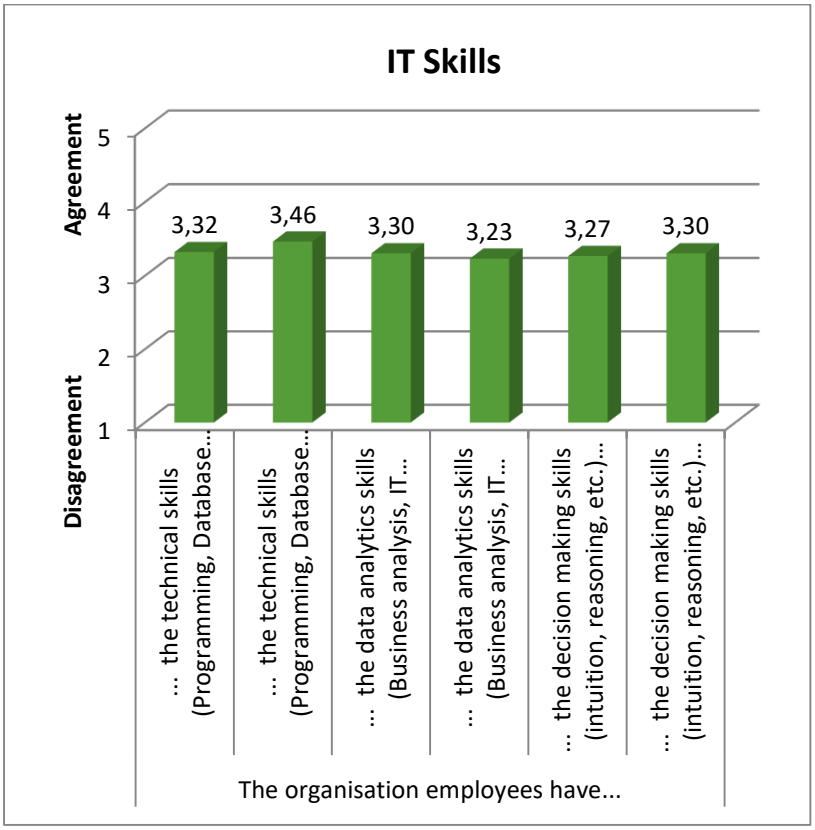


Figure 4.14: IT skills

4.4.9 Competitive Advantage

The Wilcoxon Signed Ranks test disclosed that there is significant agreement with two of the four competitive pressure statements. There was significant agreement on the following statements measuring competitive advantage:

- Pressure from competitors ensures the company strives to keep improving its performance (M=3.39, SD = 1.139), t (55) = 2.581, p=.013);
- Pressure from competitors ensures the company strives to remain competitive in the market (M=3.45, SD = .989), t (55) = 3.377, p=.001).

Figure 4.15 shows a graphical representation of the competitive pressure predictor.

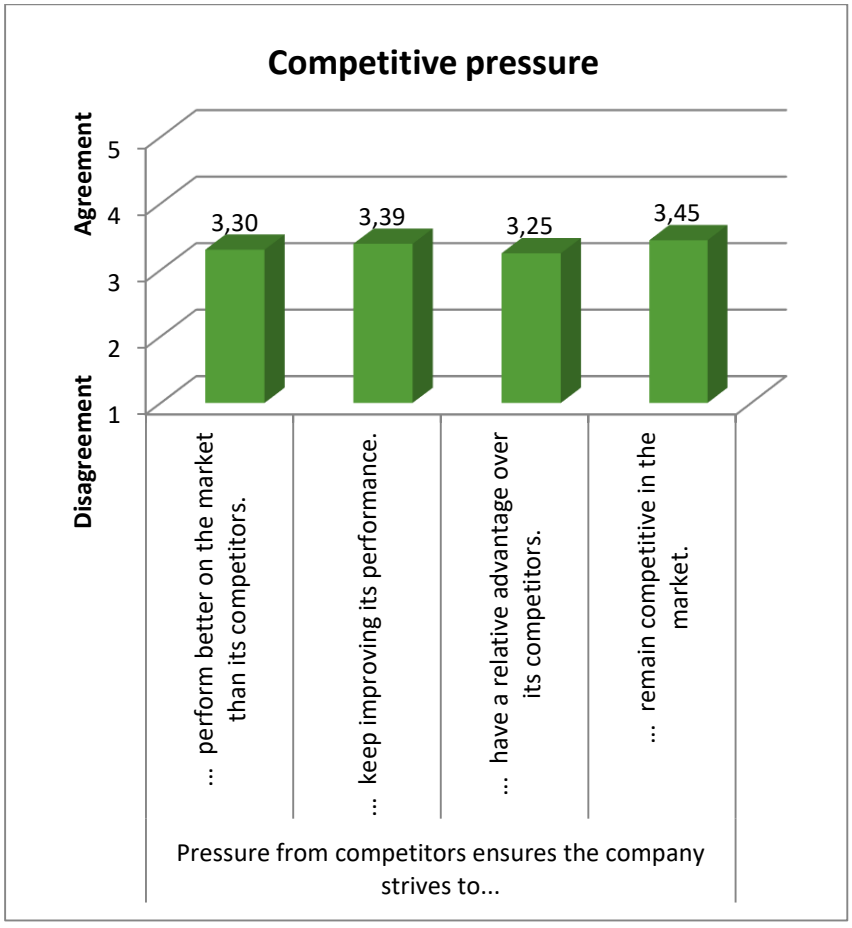


Figure 4.15: Competitive pressure

4.4.10 Laws and regulations

The Wilcoxon Signed Ranks test disclosed that there is significant agreement with all the laws and regulations statements. There was significant agreement on the following statements measuring laws and regulations:

- The organisation's operations adhere to the Electronic Communications and Transactions Act No.25 of 2002 (M=3.50, SD = .739), t (55) = 5.066, p=.000);
- The organisation's operations adhere to Regulation of Interception of Communications and Provision of Communication Related Information Act No. 70 of 2002 (M=3.59, SD = .000), t (55) = 6.016, p=.000);
- The organisation's operations adhere to King Code on Corporate Governance III (M=3.59, SD = .733), t (55) = 6.016, p=.000);
- The organisation's operations adhere to Independent Communications Authority of South Africa Act of 2000 (M=3.54, SD = .738), t (55) = 5.435, p=.000);
- The organisation's operations adhere to the Copyright Act, 1978 (Act No. 98 of 1978) (M=3.54, SD = .713), t (55) = 5.626, p=.000);
- The organisation's operations adhere to the Protection of Personal Information Act, 2013 (Act No 4 of 2013.) (M=3.41, SD = .757), t (55) = 4.058, p=.000).

Figure 4.16 shows a graphical representation of the laws and regulations predictor.

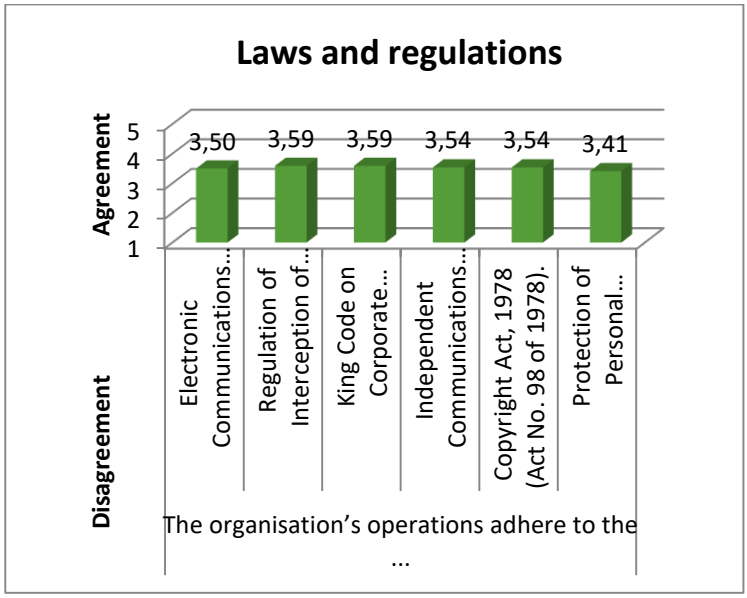


Figure 4.16: Laws and regulations

4.4.11 Customer Readiness

The Wilcoxon Signed Ranks test disclosed that there is significant agreement with two of the four customer readiness statements. There was significant agreement on the following statements measuring customer readiness:

- Customers are well informed about the business process (M=3.27, SD = .963), t (55) = 2.082, p=.042);
- The organisation's operations adhere to Regulation of Interception of Communications and Provision of Communication Related Information Act No. 70 of 2002 (M=3.50, SD = .853), t (55) = 4.387, p=.000).

Figure 4.17 shows a graphical representation of the customer readiness predictor.

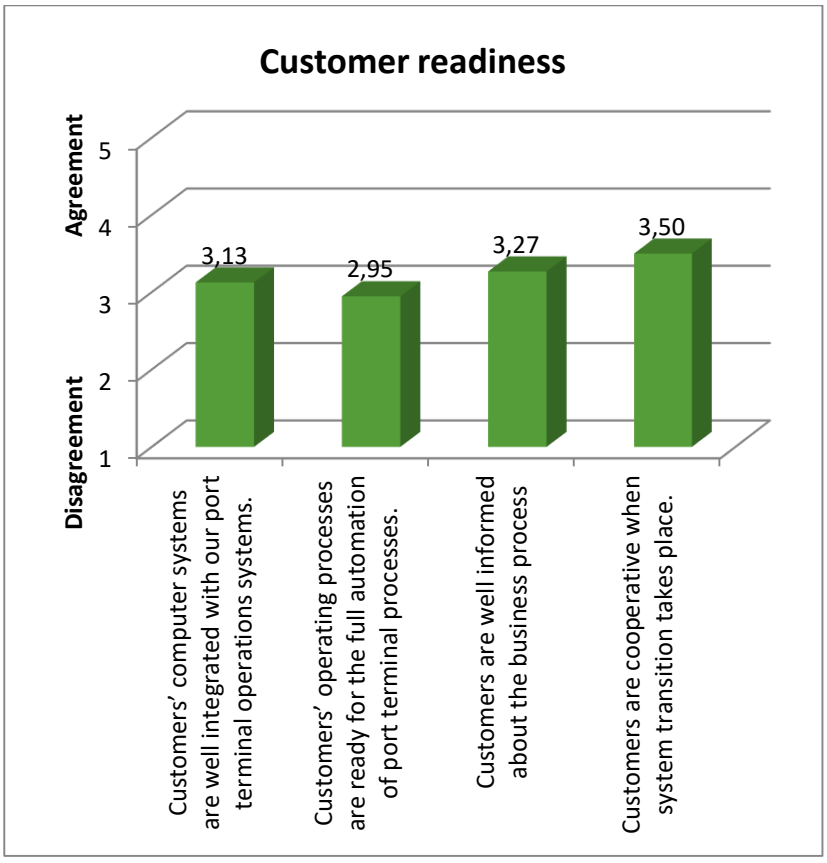


Figure 4.17: Customer readiness

4.4.12 Trading Partners Influence

The Wilcoxon Signed Ranks test disclosed that there is significant agreement with all of the trading partner's influence statements. There was significant agreement on the following statements measuring trading partners influence:

- Stakeholders (e.g. shipping agencies, trucking companies) are able to access information regarding the transportation of their goods online (M=3.39, SD = 1.003), t (55) = 2.930, p=.005);
- Stakeholders (e.g. shipping agencies, trucking companies) are able to make quicker decisions by instantly accessing information from our systems online (M=3.38, SD = 1.071), t (55) = 2.619, p=.011);
- Stakeholders (e.g. shipping agencies, trucking companies) can save costs through shorter turnaround times at port terminals (M=3.59, SD = 1.108), t (55) = 3.979, p=.000);
- Information accuracy is maintained when information is transferred between the company's systems and the stakeholders (e.g. shipping agencies, trucking companies) systems (M=3.41, SD = .930), t (55) = 3.305, p=.002).

Figure 4.18 shows a graphical representation of the trading partners influence predictor.

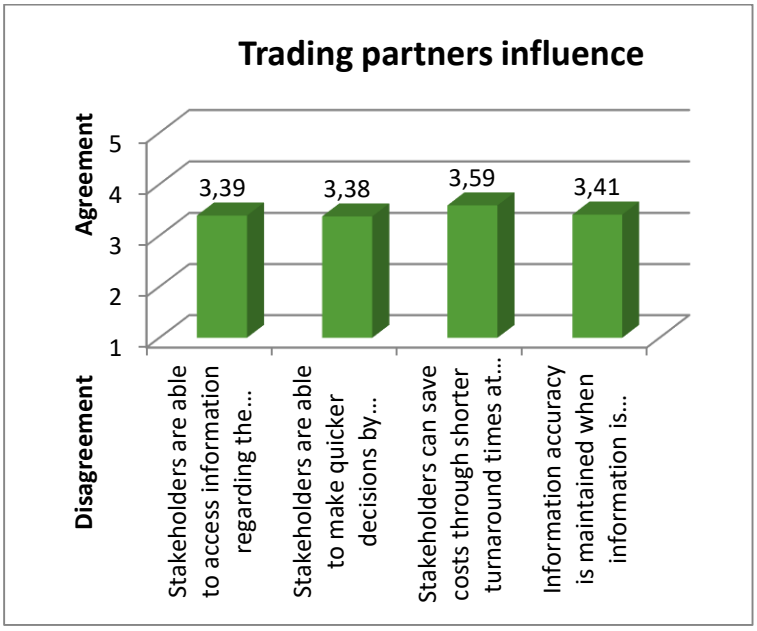


Figure 4.18: Trading partners influence

4.4.13 Adoption of an intelligent port

The Wilcoxon Signed Ranks test showed that there is significant agreement with two of the statements relating to the adoption of an intelligent port. There was significant agreement on the following statements measuring adoption of an intelligent port:

- There is significant agreement that: I think the organisation has the capability to fully automate its port terminal operations (M=3.41, SD = 1.092), t (55) = 2.815, p=.007);
- I think the organisation will successfully automate its entire port terminal operations (M=3.30, SD = 1.043), t (55) = 2.178, p=.034).

Figure 4.19 shows a graphical representation of the adoption of an intelligent port dependable variable.

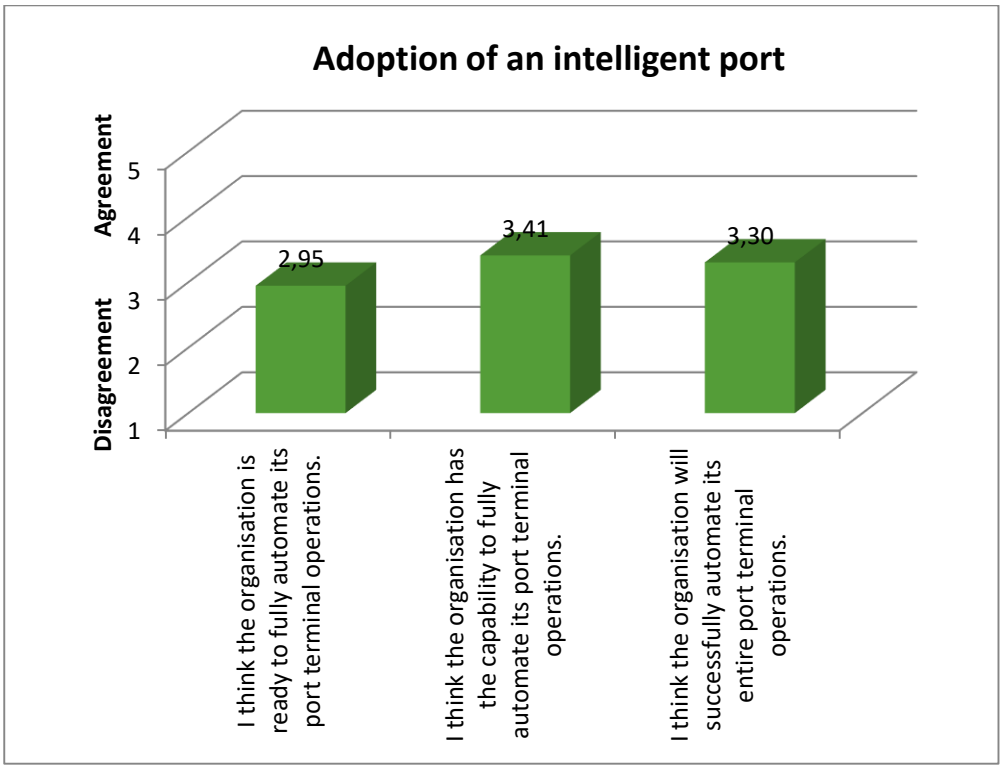


Figure 4.19: Adoption of an intelligent port

4.5 Interpretation of Regression analysis

This section predicts the value of the dependent variable against one or more other independent variables whose values are to be predetermined using a mathematical model to predict those values. Linear regression estimates the coefficients of the linear equation, relating to one or more independent variables, which best predict the value of the dependent variable (Mielniczuk & Teisseyre, 2014). The tables of these results are presented in Appendix E.

4.5.1 Independent Variable: Influence of technological factors on adoption

Regression analysis was used to test whether independent variable technological factors (i.e. availability, compatibility, complexity, security and benefits) predicted the adoption of an intelligent port. Table 4.9 shows the results obtained from the test.

Regression analysis test results

	Influencing factors	β	p	Result
B1	Availability	.233	.074	Predictor
B2	Compatibility	.321	.019	Significant predictor
B3	Complexity	.662	.000	Significant predictor
B4	Security	-.223	.153	Not a predictor
B5	Benefits	.124	.380	Predictor

Table 4.9 Regression analysis [Influence of technological factors on adoption]

The regression analysis results also indicated that these technological factors predictors accounted 62.9% (R2 = .629) of the variance of adoption, F (5, 50) = 16.924, p<.0005). Compatibility (β = .321, p=.019) and complexity (β = .662, p<.0005) are both significant predictors of perceptions of readiness to adopt an intelligent port. The regression results for independent variable: influence of technological factors on adoption are depicted in Appendix E; Table 6.1: Model Summary, Table 6.2: Coefficients and Table 6.3: ANOVA.

4.5.2 Independent Variable: Influence of organisational factors on adoption

Regression analysis was used to test whether independent variable organisational factors (i.e. structure, communication, IT skills, top management support, organisational goals) predicted the adoption of an intelligent port. Table 4.10 shows the results obtained from the test.

Regression analysis test results

	Influencing factors	β	p	Result
C1	Structure	-.133	.470	Not a predictor
C2	Communication	.505	.008	Significant Predictor
C3	IT skills	.384	.002	Significant Predictor
C4	Top management support	.215	.228	Predictor
C5	Organisational goals	-.171	.243	Not a predictor

Table 4.10 Regression analysis [Influence of organisational factors on adoption]

The regression analysis results also indicated that these organisational factors predictors account for 55.5% (R2 = .555) of the variance of adoption, F (5, 50) = 12.490, p<.0005). Communication (β = .505, p=.008) and IT Skills (β = .384, p=.002) are both significant predictors of perceptions of readiness to adopt an intelligent port. The regression results for independent variable: influence of organisational factors on adoption are depicted in Appendix E; Table 6.1: Model Summary, Table 6.2: Coefficients and Table 6.3: ANOVA.

4.5.3 Independent Variable: influence of environmental factors on adoption

Regression analysis was used to test whether independent variable environmental factors (i.e. competitive pressure, laws and regulations, customer readiness, trading partners influence) predicted the adoption of an intelligent port. Table 4.11 shows the results obtained from the test.

Regression analysis test results

	Influencing factors	β	p	Result
D1	Competitive pressure	-.010	.944	Not a predictor
D2	Laws and regulations	.089	.629	Predictor
D3	Customer readiness	.676	.000	Significant Predictor
D4	Trading partners influence	.191	.245	Predictor

Table 4.11 Regression analysis [Influence of environmental factors on adoption]

The regression analysis results also indicated that these environmental organisational factors predictors account for 49.2% (R2 = .492) of the variance of adoption, F (4, 51) = 12.357, p<.0005). Customer readiness (β = .676, p<.0005) is a significant predictor of perceptions of readiness to adopt an intelligent port. The regression results for independent variable: influence of environmental factors on adoption are depicted in Appendix E; Table 6.1: Model Summary, Table 6.2: Coefficients and Table 6.3: ANOVA.

4.6 Interpretation of The one sample *t*-test.

This section checks whether a mean score is significantly different from a scalar value. The one sample *t*-test is a statistical procedure used to determine whether a sample of observations could have been generated by a process with a specific mean (Jang, 2009). The tables of these results are presented in Appendix F.

4.6.1 Technological factors

The one sample *t*-test showed that there is significant disagreement with one aspect and significant agreement with four aspects of the technological factors statements. There was significant disagreement on the following statement measuring technological factors influence:

- The necessary technology to fully automate port terminal operations is already available (M = 2.6042, SD = .76973), t (55) = -3.848, p= .000;

There was significant agreement on the following statements measuring technological factors influence:

- The current technology is compatible to use for entirely automating the port operations (M=3.2634, SD = .90002), t (55) = 2.190, p=.033);
- The current technology is easy and simple to use (M=3.4598, SD = .79598), t (55) = 4.323, p=.000).
- The company's data and information security mechanisms are capable of securing the company's records (M=3.7083, SD = .76558), t (55) = 6.924, p=.000);
- The technology being utilised by the organisation is able to achieve the required perceived benefits (M=3.5821, SD = .82970), t (55) = 5.251, p=.000).

Figure 4.20 shows a graphical representation of the technological factors predictor.

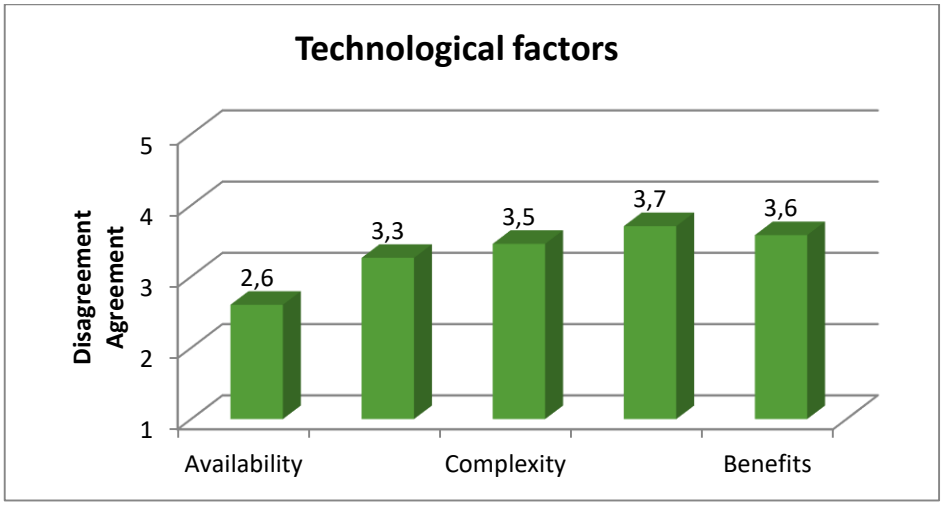


Figure 4.20: Technological factors

4.6.2 Organisational factors

The one sample *t*-test showed that there is significant agreement with one aspect of the organisational factors statements. There was significant agreement on the following statement measuring organisational factors influence:

- There is significant agreement that organisation's employees have the IT skills required to implement and maintain IT Solutions (M=3.3155, SD = .98251), t (55) = 2.403, p=.020).

Figure 4.21 shows a graphical representation of the organisational factors predictor.

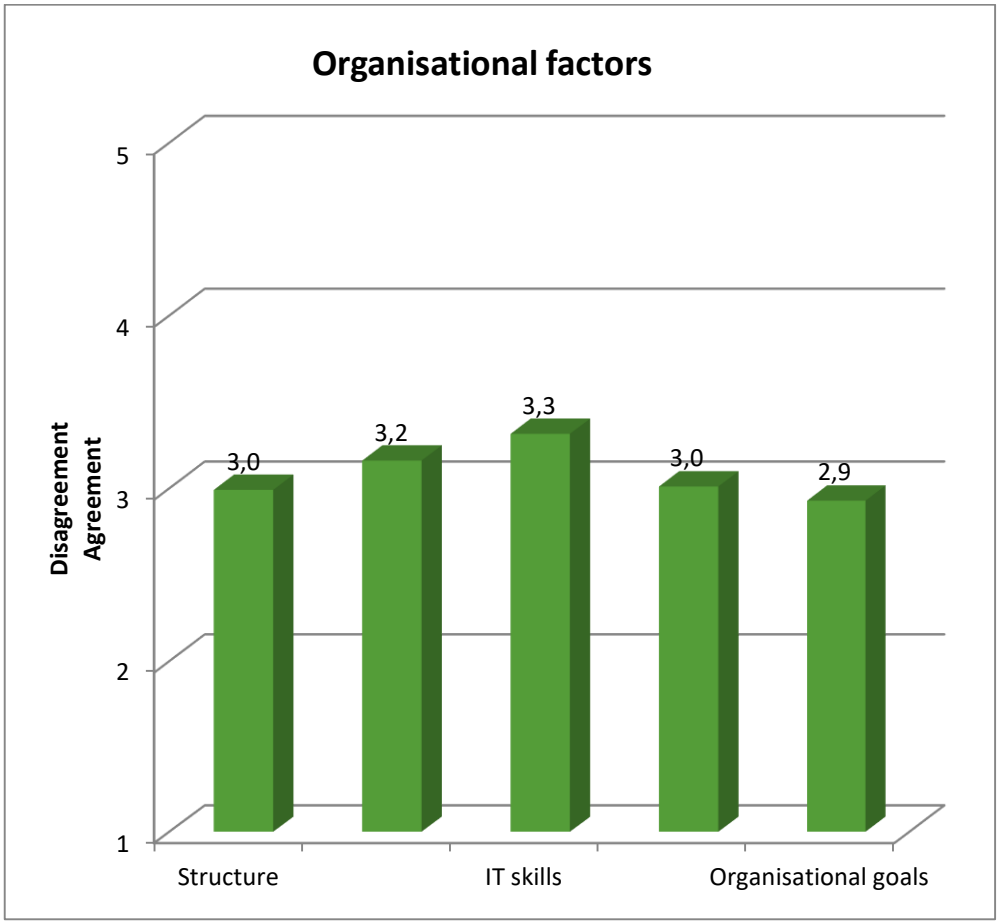


Figure 4.21: Organisational factors

4.6.3 Environmental factors

The one sample *t*-test showed that there is significant agreement with three aspects of with the environmental factors statements. There was significant agreement on the following statements measuring environmental factors influence:

- There is significant agreement that the pressure from competitors ensures the company strives to perform better than its competitors (M=3.3482, SD = 1.00981), t (55) = 2.580, p=.013);
- The organisation's operations adhere to the relevant laws and regulations related to its operations (M=3.5268, SD = .64883), t (55) = 6.076, p=.000);
- The organisation's stakeholders have an influence over the decision to fully automate operations at port terminals. (M=3.4420, SD = .89060), t (55) = 3.714, p=.000).

Figure 4.22 shows a graphical representation of the environmental factors predictor.

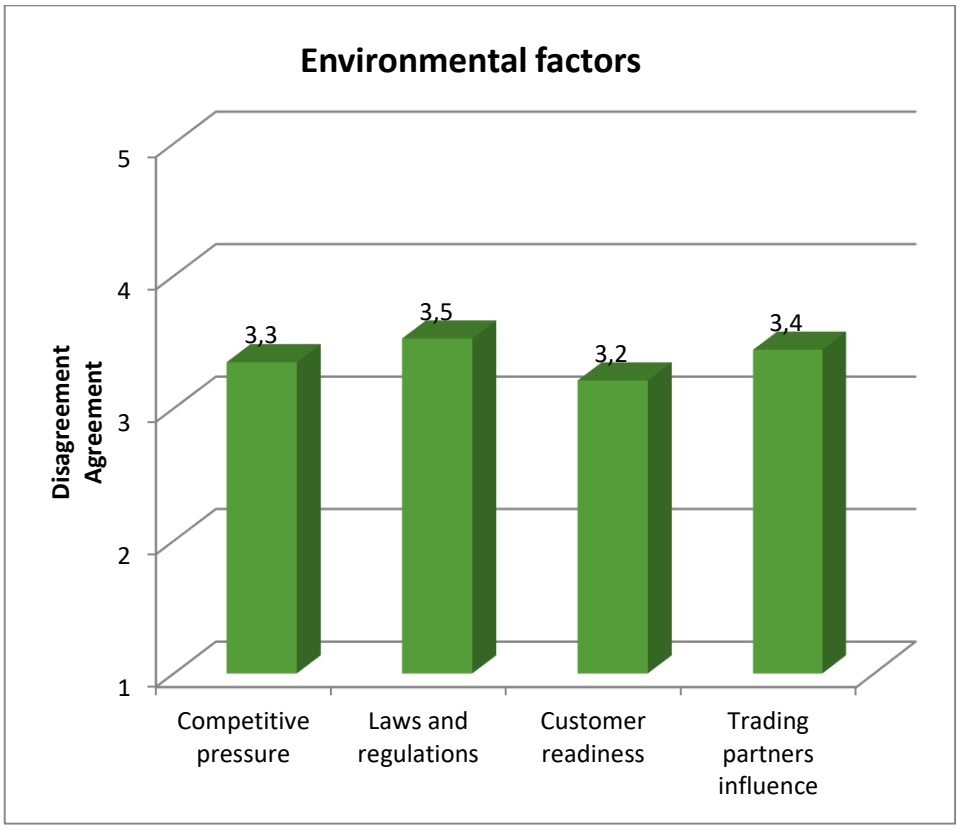


Figure 4.22 : Environmental factors

4.7 Conclusion

This chapter presented and interpreted the outcomes obtained from the following tests reliability, descriptive statistics namely frequency distributions, mean and standard deviation and inferential statistics namely Wilcoxon signed ranks test, regression analysis, and the one sample *t*-test. The results from both the Wilcoxon Signed Ranks and One sample *t*-test show that there is significant agreement amongst the employees that the necessary technology to fully automate port terminal operations is not already available; that the organisation has the IT skills required to implement and maintain IT Solutions; that pressure from competitors ensures the company strives to perform better than its competitors. The regression analysis test results also predicted that the influence of technological factors account for 62.9% of the variance of adopting an intelligent port; the influence of organisational factors account for 55.5% of the variance of adopting an intelligent port; and the influence of environmental factors account for 49.2% of the variance of adopting an intelligent port. However, the results indicate that employees think the organisation is not ready to fully automate its port terminal operations, but there is significant agreement that the organisation has the capability and will successfully automate its port terminal operations.

CHAPTER 5 : DISCUSSION

5.1 Introduction

The purpose of this chapter is to deliberate on the results, which have been presented and interpreted in the previous chapter. The outcomes were scrutinized using the facts, which have been documented in chapter two, which is literature review. This chapter will also give answers to the questions raised in this research.

5.2 Discussion of the Findings

Answers to the study enquiries raised in chapter 1 are answered using the study findings, which were presented in the previous chapter and these findings will be guided by the hypothesis of this study. The discussion of findings from this study will be presented in chronological order in which the research questions were asked in Chapter 1.2.1 as this discussion seeks to fulfil the study objectives listed in section 1.2.2.

5.2.1 Findings: Challenges and limitations

The first research question in this study was to understand the challenges and limitations with the current technology being utilised to carry out port terminal operations. This question was measured by predictors under the technology, organisational and environmental factors constructs and also the challenges and limitations experienced in port terminal operations construct (H1).

The results of the Wilcoxon Signed Ranks test in section 4.4.2 indicates that most of respondents perceive the organisation as not having the latest technology (i.e. IoT, Big Data analytics, Visualisation, Cloud Computing capabilities, Pervasive Computing and latest advances in information security) to fully automate its terminal operations. This latest technology, which the ports in Durban does not have is crucial for automating port terminal operations. This finding is consistent with literature reviewed in section 2.3.1 of this study. The result also correlates with the study conducted by Narsoo, Muslun & Sunhaloo, (2009), which states that the ports in Durban lack structural and appropriate ICT infrastructure and applications.

The results of the Wilcoxon Signed Ranks test in section 4.4.11 shows that there is a majority agreement that customers' operating processes are not yet ready for the fully automation of port terminal processes. This finding is consistent with literature reviewed in section 2.3.3 of this study. The result correlates with the study conducted by Narsoo, Muslun & Sunhaloo, (2009), which also states that most port terminal customers in the Sub-Saharan region have not yet automated their operations.

The majority of the employees also agreed that there is a lack of top management support in the form of financial support to adequately maintain and upgrade terminal operations infrastructure and systems. This finding is consistent with literature reviewed in section 2.3.2 of this study. The result also correlates with the study conducted by Mokone, (2016) which states that the lack of enough financial investments in port terminals is hampering their adoption of new technology.

The majority of the employees also agreed that labour unions and employee committees are not in favour of fully automating port operations. This finding is consistent with literature reviewed in section 2.3.3 of this study. This result also correlates with prior studies the study conducted by Chalfin, (2010) and Jones, (2005) that states that labour unions are the biggest resistor to changes in the way employees work in terminal port operations as they presume it will lead to job losses.

5.2.2 Findings: The influence of technological factors

The second question in this study was to understand the influence of technological factors on the adoption of an intelligent port terminal in Durban. The one sample *t*-test was used to measure technological predictors influence on the adoption of an intelligent port terminal and the outcomes are listed in section 4.6.1 showing that the majority of the respondents perceiving that when looking at technology as a whole, there is disagreement that necessary technology is available, but agreement that the other aspects (Compatibility, Complexity, Security, Benefits) are adequate.

Regression analysis was used to test the influence of technological factors (Availability, Compatibility, Complexity, Security and benefits) on the adoption of an intelligent port terminal in Durban. Results in section 4.5.1 indicated that these predictors accounted for 62.9% (R2 = .629) of the variance of adoption, F (5, 50) = 16.924, p<.0005). Compatibility (β = .321, p=.019) and complexity (β = .662, p<.0005) are both significant predictors of perceptions of readiness to adopt an intelligent port in Durban. The influence of technological factors and the perceptions found from the study are discussed in detail below.

5.2.2.1 Technology availability

Technology availability (H2) is a predictor of perceptions of readiness to adopt an intelligent port with the result (β = .233, p=.074). This result shows that technology availability has an influence over the adoption of an intelligent port terminal in Durban. This finding is consistent with literature reviewed in section 2.3.1 of this study. The result also correlates with prior studies such conducted by Chalfin, (2010); Lee, Kim & Ahn, 20(11) and Rahayu & Day, (2015) which states that technology availability positively influences the adoption of a new technology.

5.2.2.2 Technology competence

Technology compatibility (H3) is a significant predictor of perceptions of readiness to adopt an intelligent port with the result (β = .321, p=.019). This result shows that technology compatibility has a greater influence over the adoption of an intelligent port terminal in Durban. This finding is consistent with literature reviewed in section 2.3.1 of this study. The result also correlates with prior studies conducted by Rahayu & Day, (2015); Oliveira, Thomas & Espadanal, (2014) and Zhu & Kraemer, (2005) which states that technology competence positively influences the adoption of a new technology.

5.2.2.3 Technology complexity

Technology complexity (H4) is a significant predictor of perceptions of readiness to adopt an intelligent port with the result (β = .662, p<.0005). This result shows that technology complexity has a greater influence over the adoption of an intelligent port terminal in Durban. The result correlates with prior studies conducted by Brown and Bakhru, (2007) and Riggins and Slaughter, (2006) which states that the more complex a form of technology is, the less possible it is for it to be successfully applied. When a form of technology is very difficult for an organization to apply, upper management teams decide to either abandon it or to introduce it later (Low, Chen & Wu, 2011).

5.2.2.4 Data and Information Security

Data and information security (H5) is not a predictor of perceptions of readiness to adopt an intelligent port with the results (β = -.223, p=.153). This result shows that data and information security has no influence over the adoption of an intelligent port terminal in Durban. This finding is not consistent with literature reviewed in section 2.3.1 of this study. The result refutes with prior studies conducted by Loebbecke et al., (2012); Benlian & Hess, (2011) and Bhattacherjee & Park, (2014), which states that for intelligent and smart technology to be successfully adopted in an organisation there is a need ensure that there is data integrity and confidentiality between the parties exchanging information.

5.2.2.5 Perceived Benefits

Perceived Benefits (H6) is a predictor of perceptions of readiness to adopt an intelligent port with the results (β = .124, p=.380). This result shows that perceived benefits has an influence over the adoption of an intelligent port terminal in Durban. This finding is consistent with literature reviewed in section 2.3.1 of this study. The result correlates with prior studies conducted by Kuan and Chau, (2001); Brown & Russel, (2007) and Seymour et al., (2010) which states that perceived benefits positively influence the adoption of a new technology.

5.2.3 Findings: The influence of organizational factors

The third question in this study was to understand the influence of organizational factors on the adoption of an intelligent port terminal at port terminals in Durban. The one sample *t*-test was used to measure organisational predictors influence on the adoption of an intelligent port terminal and the outcomes are listed in section 4.6.2 showing that the majority of the respondents perceiving that when looking at the organisation as a whole, there is disagreement that necessary organisational goals are available, but agreement that the other aspects (Structure, communication, IT skills, and Top management support) are adequate.

Regression analysis was used to test the influence of organisational factors (Structure, Communication, IT skills, Top management support, Organisational goals) on the adoption of an intelligent port terminal at port terminals in Durban. Results in section 4.5.2 indicated that these account for 55.5% (R2 = .555) of the variance of adoption, F (5, 50) = 12.490, p<.0005). Communication (β = .505, p=.008) and IT Skills (β = .384, p=.002) are both significant predictors of perceptions of readiness to adopt an intelligent port in Durban. The Organisational factors predictors and the perceptions found from the study are discussed in detail below.

5.2.3.1 Organisational structure

Organisational structure (H7) is not a predictor of perceptions of readiness to adopt an intelligent port with the results (β = -.133, p=.470). This result shows that organisational structure has no influence over the adoption of an intelligent port terminal in Durban. This finding is not consistent with literature reviewed in section 2.3.2 of this study. The result refutes with prior studies conducted by Rahayu & Day, (2015) which states that organisational structure positively influences the adoption of a new technology.

5.2.3.2 Communication process

Communication process (H8) is a significant predictor of perceptions of readiness to adopt an intelligent port with the results (β = .505, p=.008). This result shows that communication process has a greater influence over the adoption of an intelligent port terminal in Durban. This finding is consistent with literature reviewed in section 2.3.2 of this study. The result also correlates with prior studies conducted by Rahayu & Day, (2015) and Zhu & Kraemer, (2005) which states that communication between stakeholders is crucial for the success of adopting a new technology.

5.2.3.3 IT Skills

IT Skills (H9) is a significant predictor of perceptions of readiness to adopt an intelligent port with the results (β = .384, p=.002). This result shows that IT Skills have a greater influence over the adoption of an intelligent port terminal in Durban. This finding is consistent with literature reviewed in section 2.3.2 of this study. The result also correlates with prior studies conducted by Leimeister et al., (2007) and Koh et al., (2011); Rahayu & Day, (2015) which states that IT Skills positively influence the adoption of a new technology.

5.2.3.4 Top management support

Top management support (H10) is a predictor of perceptions of readiness to adopt an intelligent port with the results (β = .215, p=.228). This result shows that top management has an influence over the adoption of an intelligent port terminal in Durban. This finding is consistent with literature reviewed in section 2.3.2 of this study. The result correlates with prior studies conducted by Sharma et al. (2008) and Brown and Russel, (2007), which states that top management support is crucial in guiding and encouraging the transformation of an organisation from operating manually to automating its process.

5.2.3.5 Organisational goals

Organisational goals (H11) is not a predictor of perceptions of readiness to adopt an intelligent port with the results (β = -.171, p=.243). This result shows that organisational goals have no influence over the adoption of an intelligent port terminal in Durban. This finding is not consistent with literature reviewed in section 2.3.2 of this study. The result refutes prior studies conducted by Zhu & Kraemer, (2005) which states that organisational goals tend to drive the adoption of the latest technology on the market, if it can help an organisation achieve its goals.

5.2.4 Findings: The influence of environmental factors

The fourth question in this study was to understand the influence of environmental factors on the adoption of an intelligent port terminal at port terminals in Durban. The one sample *t*-test was used to measure environmental predictors influence on the adoption of an intelligent port terminal and the outcomes are listed in section 4.6.3. Showing that the majority of the respondents perceiving that when looking at the environment as a whole, there is significant agreement that pressure from competitors ensures the company strives to perform better than its competitors, operations adhere to the relevant laws and regulations and the stakeholders have an influence over the decision to fully automate operations at port terminals.

Regression analysis was used to test the influence of the environmental factors (competitive pressure, laws and regulations, customer readiness and trading partners influence) on the adoption of an intelligent port terminal at port terminals in Durban. Results indicated that these account for 49.2% (R2 = .492) of the variance of adoption, F (4, 51) = 12.357, p<.0005). Customer readiness (β = .676, p<.0005) is a significant predictor of perceptions of readiness to adopt an intelligent port. The environmental factors predictors and the perceptions found from the study are discussed in detail below.

5.2.4.1 Competitive pressure

Competitive pressure (H12) is not a predictor of perceptions of readiness to adopt an intelligent port with the results (β = -.010, p=.944). This result shows that competitive pressure has no influence over the adoption of an intelligent port terminal in Durban. This finding is not consistent with literature reviewed in section 2.3.3 of this study and the result refutes prior studies conducted by Rahayu & Day, (2015) which states that competitive pressure positively influences the adoption of a new technology but correlates findings from studies conducted by Zhu & Kraemer, (2005) which states that competitor's influence has no direct effect on the adoption of a new technology.

5.2.4.2 Laws and Regulations

Laws and regulations (H13) is a predictor of perceptions of readiness to adopt an intelligent port with the results (β = .089, p=.629). This result shows that laws and regulations have an influence over the adoption of an intelligent port terminal in Durban. This finding is consistent with literature reviewed in section 2.3.3 of this study and the result correlates with prior studies conducted by Zhu & Kraemer (2005), which states that firms facing higher regulatory support are more likely to successfully adopt a new technology.

5.2.4.3 Customer Readiness

Customer readiness (H14) is a significant predictor of perceptions of readiness to adopt an intelligent port with the results (β = .676, p<.0005). This result shows that customer readiness has a greater influence over the adoption of an intelligent port terminal in Durban. This finding is consistent with literature reviewed in section 2.3.3 of this study and the result refutes prior studies conducted by Rahayu & Day, (2015); Son & Han, (2011) and Yousafzai & Yani-de-Soriano, (2012) which states that customer readiness has no positive and significant correlation with the adoption of a new technology.

5.2.4.4 Trading Partners Influence

Trading partners influence (H15) is a predictor of perceptions of readiness to adopt an intelligent port with the results (β = .191, p=.245). This result shows that trading partners have an influence over the adoption of an intelligent port terminal in Durban. This finding is consistent with literature reviewed in section 2.3.3 of this study and the result refutes prior studies conducted by Rahayu & Day, (2015); Yang and Jarvenpaa, (2005) and Shi & Yan, (2016) which states that trading partner's pressure has no positive and significant correlation with the adoption of a new technology.

5.2.5 Findings: Adoption of an intelligent port terminal

The results of the Wilcoxon Signed Ranks test in section 4.4.12 shows that the majority of the respondents significantly agree with the following statements, I think the organisation has the capability to fully automate its port terminal operations. (M=3.41, SD = 1.092), t (55) = 2.815, p=.007) and I think the organisation will successfully automate its entire port terminal operations. (M=3.30, SD = 1.043), t (55) = 2.178, p=.034). The majority of the respondents disagreed with the statement that the organisation is ready to fully automate its port terminal operations.

5.3 Conclusion

The discussion of the results provides answers to the research questions of this study. Amongst other things revealed by this chapter is that the current technology used by the organisation would not enable the organisation to fully automate its port terminal operations, Customers' processes and systems are not yet ready to integrate with the organisation's systems and process if they are to be fully automated. There is no sufficient top management in the form of financial support to adequately maintain and upgrade terminal operations infrastructure and systems. The labour unions and employee committees are not in favour of fully automating port terminal operations. Technological factors influence on the adoption of and intelligent port terminal accounted for 62.9% of the variance of adopting an intelligent port, with organisational factors influence accounting for 55.5% of the variance of adopting an intelligent port and environmental factors influence accounting for 49.2% of the variance of adopting an intelligent port. The majority of the respondents disagree that the organisation is ready to fully automate its port terminal operations but agree that it is capable and will successfully automate its entire port terminal operations.

CHAPTER 6 : CONCLUSION

6.1 Introduction

The broad objective of this chapter is to summarize the findings of this study, in so doing we will be trying to deduce meaning from each finding which relates to the adoption of an intelligent port terminal by ports in Durban. Furthermore, this chapter highlights the limitations of the study, contribution of the study to the body of knowledge and offering recommendations for future research in the same field.

6.2 Summary of main research findings

In this study the TOE framework was utilised as a baseline to assess the extent to, which factors such as the technology, organisation and environment have on the adoption of an intelligent port terminal in Durban. Challenges and limitations faced by the current technology being utilised by the organisations at their port terminals in Durban were also analysed. This study was necessitated by the fact that competition among port terminals around the world is increasing and these ports are beginning to tap into each other's market share. As the competition increases ports are looking for better mechanisms to carry out their operations in a less costly and most effective way.

Most port terminals around the world are adopting an intelligent/smart port as a way to effectively perform their day to day business in a less costly way. This enables them to defend and then increase their market share as they are able to get more business from ports, which have not yet adopted intelligent / smart port terminals. The study looks at the capability of port terminals in Durban to also adopt an intelligent port terminal in order to remain viable and competitive on the market. It also seeks to identify and unpack the factors that influence the adoption of an intelligent port terminal in the city of Durban.

Findings from this study reveal that the challenges and limitations faced by port terminals in Durban are that it does not have the latest technology, there is a lack of financial support from management to acquire the latest technology and customers are not yet ready for a fully automated port terminal. To promote customer readiness before implementation, there is a need to introduce awareness and training campaigns and ensure customer systems are inter-operable with the intelligent port terminal systems.

On fully automating port terminals in Durban technology factors have the biggest influence and the latest technology such as (IOT, Big Data analytics, Visualisation, Cloud Computing capabilities, Pervasive Computing and latest advances in information security) has to be acquired, followed by organisational factors such as financial support from management and critical IT skills are required in the organisation. Environmental factors have the least influence on the adoption of an intelligent port terminal, although customer readiness will need to be given attention.

The results of this study showed that port terminals in Durban are not yet ready to adopt an intelligent port terminal as there are currently technological, organisational and environmental challenges and limitations. However, if these challenges and limitations are addressed the port terminals in Durban are capable and will successfully adopt an intelligent port terminal.

6.3 Contribution of study

The findings of this study will help port terminals in South Africa especially those operating in Durban to be able to understand the current challenges and limitations being faced by port terminals in Durban. It will also provide knowledge on the technological, organisational and environmental factors which influence the adoption of an intelligent port terminal. The study will also reveal if port terminals in Durban are ready to adopt an intelligent port terminal and if not yet ready what steps are required for them to be ready to adopt an intelligent port terminal.

6.4 Limitations of the study

The study faced some limitations, firstly it was conducted in Durban only and on three port terminals instead of covering the whole country and all 10 port terminals in South Africa. The study also focused on EIMS employees as its participants instead of all employees from the organisation. The research had to be done with the quantitative methodology as other methods of research will have required more time and resources. Financial and time constraints limited this research to the scope it covered. Extending the study to cover the whole country would have cost a lot more as there will have been the need to travel around the country. The duration in which the study had to be completed also limited the study to be carried out in Durban only.

6.5 Recommendations for future research

Limitations of this study have afforded some valuable future research for scholars to consider. The first future research would be a study to further test the proposed model for similar results in a different context namely South African province, African country, the Southern African region or African continent. Secondly, other factors, which could affect the adoption of an intelligent port terminal could be explored, not limited to the proposed model.

6.6 Conclusion

The organisation must seize the opportunity to increase its market share by striving towards fully automating its port terminal operations and adopting an intelligent port terminal. With many ports in Africa having not yet adopted an intelligent port, ports in Durban will be amongst the first to do so in the region. Although this research can be generalised in Durban more studies still needs to be done using different research methodologies. Studies can also be done in other regions so that the findings if similar can be generalised to the whole country or continent.

REFERENCES

Abdelwahab, S., Hamdaoui, B., Guizani, M., & Rayes, A. (2014). Enabling Smart Cloud Services Through Remote Sensing: An Internet of Everything Enabler. *IEEE Internet Of Things Journal*, 1(3), 276-288. Http://dx.doi.org/10.1109/jiot.2014.2325071

Achten, H. (2005). Digital Ground: Architecture, Pervasive Computing, and Environmental Knowledge by Malcolm mccullough. *International Journal Of Architectural Computing*, *3*(2), 255-258. Http://dx.doi.org/10.1260/1478077054214433

Albino, V., Berardi, U., & Dangelico, R. (2015). Smart Cities: Definitions, Dimensions, Performance, and Initiatives. *Journal Of Urban Technology*, *22*(1), 3-21. Http://dx.doi.org/10.1080/10630732.2014.942092

Ali, O., Soar, J., & Yong, J. (2015). An investigation of the challenges and issues influencing the adoption of cloud computing in Australian regional municipal governments. *Journal Of Information Security And Applications*. Http://dx.doi.org/10.1016/j.jisa.2015.11.006

Almabhouh, A., Saleh, A., & Ahmad, A. (2011). Examining the Influence of Relationship Quality on Data Warehouse Success. *International Journal Of Modeling And Optimization*, 402-409. Http://dx.doi.org/10.7763/ijmo.2011.v1.68

Angelidou, M. (2014). Smart city policies: A spatial approach. *Cities*, *41*, S3-S11. Http://dx.doi.org/10.1016/j.cities.2014.06.007

Antoniadis, I., Tsiakiris, T., & Tsopogloy, S. (2015). Business Intelligence During Times of Crisis: Adoption and Usage of ERP Systems by smes. *Procedia - Social And Behavioral Sciences*, *175*, 299-307. Http://dx.doi.org/10.1016/j.sbspro.2015.01.1204

Ao, Q. (2014). Analysis the Transformation and Upgrading Path of the Ports in Pearl River Delta. *Applied Mechanics And Materials*, *587-589*, 1771-1775. http://dx.doi.org/10.4028/www.scientific.net/amm.587-589.1771

Appelbaum, S., Karelis, C., Le Henaff, A., & mclaughlin, B. (2017). Resistance to change in the case of mergers and acquisitions: part 2. *Industrial And Commercial Training*, *49*(3), 139-145. Http://dx.doi.org/10.1108/ict-05-2016-0033

Barros, C., & Peypoch, N. (2012). Productivity assessment of African seaports with biased technological change. *Transportation Planning And Technology*, *35*(6), 663-675. Http://dx.doi.org/10.1080/03081060.2012.710033

Bernroider, E., & Schmöllerl, P. (2013). A technological, organisational, and environmental analysis of decision making methodologies and satisfaction in the context of IT induced business transformations. *European Journal Of Operational Research*, *224*(1), 141-153. Http://dx.doi.org/10.1016/j.ejor.2012.07.025

Bitarafan, M., Zolfani, S., Arefi, S., Zavadskas, E., & Mahmoudzadeh, A. (2014). Evaluation of real-time intelligent sensors for structural health monitoring of bridges based on swara-waspas; a case in Iran. *The baltic journal of road and bridge engineering*, *9*(4), 333-340. Http://dx.doi.org/10.3846/bjrbe.2014.40

Bosch-Rekveldt, M., Jongkind, Y., Mooi, H., Bakker, H., & Verbraeck, A. (2011). Grasping project complexity in large engineering projects: The TOE (Technical, Organizational and Environmental) framework. *International Journal Of Project Management*, *29*(6), 728-739. Http://dx.doi.org/10.1016/j.ijproman.2010.07.008

Brown, A., & Bakhru, A. (2007). Information systems innovation research and the case Of rfid. *Ifip international federation for Information Processing, 235*, 363-376.

Brown, I., & Russell, J. (2007). Radio frequency identification technology: An exploratory study on adoption in the South African retail sector. *International Journal Of Information Management, 27*(4), 250-265. http://dx.doi.org/10.1016/j.ijinfomgt.2007.02.007

Cardone, G., Foschini, L., Bellavista, P., Corradi, A., Borcea, C., Talasila, M., & Curtmola, R. (2013). Fostering participaction in smart cities: a geo-social crowdsensing platform. *IEEE Commun. Mag.*, *51*(6), 112-119. Http://dx.doi.org/10.1109/mcom.2013.6525603

Carlo, H., Vis, I., & Roodbergen, K. (2014). Storage yard operations in container terminals: Literature overview, trends, and research directions. *European Journal Of Operational Research*, *235*(2), 412-430. Http://dx.doi.org/10.1016/j.ejor.2013.10.054

Carlo, H., Vis, I., & Roodbergen, K. (2014). Transport operations in container terminals: Literature overview, trends, research directions and classification scheme. *European Journal Of Operational Research, 236*(1), 1-13. Http://dx.doi.org/10.1016/j.ejor.2013.11.023

CEO of Transnet Port Terminals. (2013). The role of TPT in the export-led growth strategy in the Eastern Cape - Challenges and opportunities. Retrieved from https://www.transnetportterminals.net/Media/Publications%20Paper%20and%20Presentation/EC%20Maritime%20Conference.pdf

Chalfin, B. (2010). Recasting maritime governance in Ghana: the neo-developmental state and the Port of Tema. *The Journal Of Modern African Studies*, *48*(04), 573-598. Http://dx.doi.org/10.1017/s0022278x10000546

Chang, H. (2010). A new perspective on Twitter hashtag use: Diffusion of innovation theory. *Proc. Am. Soc. Info. Sci. Tech.*, *47*(1), 1-4. Http://dx.doi.org/10.1002/meet.14504701295

Chen, L., Zhang, D., Ma, X., Wang, L., Li, S., Wu, Z., & Pan, G. (2016). Container Port Performance Measurement and Comparison Leveraging Ship GPS Traces and Maritime Open Data. *IEEE Transactions On Intelligent Transportation Systems*, *17*(5), 1227-1242. Http://dx.doi.org/10.1109/tits.2015.2498409

Chen, T., Lee, P., & Notteboom, T. (2013). Shipping line dominance and freight rate practices on trade routes: the case of the Far East-South Africa trade. *IJSTL*, *5*(2), 155. Http://dx.doi.org/10.1504/ijstl.2013.053233

Choo, K. (2011). The Cyber Threat Landscape: Challenges and Future Research Directions. *SSRN Electronic Journal*. Http://dx.doi.org/10.2139/ssrn.2339821

Ciuriak, D. (2017). Trade, Innovation, and Development: The Role of Diversification in Driven Economic Systems. *SSRN Electronic Journal*. Http://dx.doi.org/10.2139/ssrn.2963723

Cloud Based Logistics Management System, Warehouse Management System – Exaact.co. (2017). Exaact.co. Retrieved 13 November 2017, from http://www.exaact.co/performance.html

Cook, W., & Seiford, L. (2009). Data envelopment analysis (DEA) – Thirty years on. *European Journal Of Operational Research*, *192*(1), 1-17. Http://dx.doi.org/10.1016/j.ejor.2008.01.032

Creswell, J., & Plano Clark, V. (2009). *Designing and conducting mixed methods research*. Thousand Oaks: Sage.

Cullinane, K., Wang, T., Song, D., & Ji, P. (2006). The technical efficiency of container ports: Comparing data envelopment analysis and stochastic frontier analysis. *Transportation Research Part A: Policy And Practice*, *40*(4), 354-374. Http://dx.doi.org/10.1016/j.tra.2005.07.003

Dadashi, N., Wilson, J., Golightly, D., & Sharples, S. (2014). A framework to support human factors of automation in railway intelligent infrastructure. *Ergonomics, 57*(3), 387-402. Http://dx.doi.org/10.1080/00140139.2014.893026

De Martino, M. (2014). Sustainable Development Strategies of the Port Authority: The Network Approach. *Advanced Engineering Forum, 11*, 87-95. Http://dx.doi.org/10.4028/www.scientific.net/aef.11.87

Dearing, J. (2009). Applying Diffusion of Innovation Theory to Intervention Development. *Research On Social Work Practice*, *19*(5), 503-518. Http://dx.doi.org/10.1177/1049731509335569

Dedrick, J., Venkatesh, M., Stanton, J., Zheng, Y., & Ramnarine-Rieks, A. (2014). Adoption of smart grid technologies by electric utilities: factors influencing organizational innovation in a regulated environment. *Electronic Markets*, *25*(1), 17-29. Http://dx.doi.org/10.1007/s12525-014-0166-6

Demirkan, H., & Delen, D. (2013). Leveraging the capabilities of service-oriented decision support systems: Putting analytics and big data in cloud. *Decision Support Systems*, *55*(1), 412-421. http://dx.doi.org/10.1016/j.dss.2012.05.048

Derrac, J., García, S., Molina, D., & Herrera, F. (2011). A practical tutorial on the use of nonparametric statistical tests as a methodology for comparing evolutionary and swarm intelligence algorithms. *Swarm And Evolutionary Computation, 1*(1), 3-18. http://dx.doi.org/10.1016/j.swevo.2011.02.002

Dooms, M., van der Lugt, L., & de Langen, P. (2013). International strategies of port authorities: The case of the Port of Rotterdam Authority. *Research In Transportation Business & Management, 8,* 148-157. Http://dx.doi.org/10.1016/j.rtbm.2013.06.004

D'Orazio, C., Choo, K., & Yang, L. (2017). Data Exfiltration From Internet of Things

Devices: IOS Devices as Case Studies. *IEEE Internet Of Things Journal*, *4*(2), 524-535. Http://dx.doi.org/10.1109/jiot.2016.2569094

Ducruet, C., & Notteboom, T. (2012). The worldwide maritime network of container shipping: spatial structure and regional dynamics. *Global Networks*, *12*(3), 395-423. Http://dx.doi.org/10.1111/j.1471-0374.2011.00355.x

Dulle, F., & Minishi-Majanja, M. (2011). The suitability of the Unified Theory of Acceptance and Use of Technology (UTAUT) model in open access adoption studies. *Information Development*, *27*(1), 32-45. Http://dx.doi.org/10.1177/0266666910385375

Dwarakish, G., & Salim, A. (2015). Review on the Role of Ports in the Development of a Nation. *Aquatic Procedia, 4*, 295-301. Http://dx.doi.org/10.1016/j.aqpro.2015.02.040

Easterby-Smith, M., & Prieto, I. (2008). Dynamic Capabilities and Knowledge Management: an Integrative Role for Learning?*. *British Journal Of Management*, 19(3), 235-249. Http://dx.doi.org/10.1111/j.1467-8551.2007.00543.x

Eaton, J., Kortum, S., Neiman, B., & Romalis, J (2010). Trade and the Global Recession. *SSRN Electronic Journal*. http://dx.doi.org/10.2139/ssrn.1692582

Elsner, W. (2010). Regional service clusters and networks. Two approaches to empirical identification and development: the case of logistics in the German port city-states Hamburg and Bremen. *International Review Of Applied Economics, 24*(1), 1-33. Http://dx.doi.org/10.1080/02692170903007573

Ercan, T. (2010). Effective use of cloud computing in educational institutions. *Procedia - Social And Behavioral Sciences, 2*(2), 938-942. Http://dx.doi.org/10.1016/j.sbspro.2010.03.130

Esteva-Armida, E., & Rubio-Sanchez, A. (2012). Adoption Process for voip. *International Journal Of E-Services And Mobile Applications*, *4*(4), 15-31. Http://dx.doi.org/10.4018/jesma.2012100102

Felício, J., & Caldeirinha, V. (2013). The influence of the characterisation factors of the European ports on operational performance: conceptual model testing. *IJSTL*, *5*(3), 282. Http://dx.doi.org/10.1504/ijstl.2013.054191

Fernández, P., Santana, J., Ortega, S., Trujillo, A., Suárez, J., & Domínguez, C. (2016). Smartport: *A Platform for Sensor Data Monitoring in a Seaport Based on fiware*. *Sensors*, *16*(3), 417. Http://dx.doi.org/10.3390/s16030417

Ferretti, M., & Schiavone, F. (2016). Internet of Things and business processes redesign in seaports: The case of Hamburg. *Business Process Management Journal*, *22*(2), 271-284. Http://dx.doi.org/10.1108/bpmj-05-2015-0079

Garlan, D., Siewiorek, D., Smailagic, A., & Steenkiste, P. (2002). Project Aura: toward distraction-free pervasive computing. *IEEE Pervasive Computing*, *1*(2), 22-31. Http://dx.doi.org/10.1109/mprv.2002.1012334

Gil-Garcia, J., Pardo, T., & Nam, T. (2015). What makes a city smart? Identifying core components and proposing an integrative and comprehensive conceptualization. *Information Polity*, *20*(1), 61-87. Http://dx.doi.org/10.3233/ip-150354

Gladys Nduku, M., & Nzuki, D. (2014). Determinants of Adoption of Enterprise Resource Planning Systems by Listed Companies in Kenya. *IOSR Journal Of Business And Management*, *16*(8), 45-50. Http://dx.doi.org/10.9790/487x-16834550

Grant, D. (2016). Business analysis techniques in business reengineering. *Business Process Management Journal*, *22*(1), 75-88. Http://dx.doi.org/10.1108/bpmj-03-2015-0026

Gubbi, J., Buyya, R., Marusic, S., & Palaniswami, M. (2013). Internet of Things (iot): A vision, architectural elements, and future directions. *Future Generation Computer Systems, 29*(7), 1645-1660. Http://dx.doi.org/10.1016/j.future.2013.01.010

Hakam, H., Solvang, W., & Pieskä, S. (2014). RFID-based communication in container ports. *Intelligent Decision Technologies, 9*(1), 3-16. Http://dx.doi.org/10.3233/idt-140201

Hall, P., & Jacobs, W. (2010). Shifting Proximities: The Maritime Ports Sector in an Era of Global Supply Chains. *Regional Studies, 44*(9), 1103-1115. Http://dx.doi.org/10.1080/00343400903365110

Hasan, M., Hossain, E., & Niyato, D. (2013). Random access for machine-to-machine communication in LTE-advanced networks: issues and approaches. *IEEE Communications Magazine*, 51(6), 86-93. Http://dx.doi.org/10.1109/mcom.2013.6525600

Hashemi, S. (2013). Cloud Computing Technology: Security and Trust Challenges. *International Journal Of Security, Privacy And Trust Management, 2*(5), 1-7. Http://dx.doi.org/10.5121/ijsptm.2013.2501

Hein, C. (2016). Port cityscapes: conference and research contributions on port cities. *Planning Perspectives, 31(*2), 313-326. Http://dx.doi.org/10.1080/02665433.2015.1119714

Hodkinson, P., & Macleod, F. (2010). Contrasting concepts of learning and contrasting research methodologies: affinities and bias. *British Educational Research Journal, 36*(2), 173-189. http://dx.doi.org/10.1080/01411920902780964

Holden, R., & Karsh, B. (2010). The Technology Acceptance Model: Its past and its future in health care. *Journal Of Biomedical Informatics, 43*(1), 159-172. Http://dx.doi.org/10.1016/j.jbi.2009.07.002

Hollen, R., van den Bosch, F., & Volberda, H. (2014). Strategic levers of port authorities for industrial ecosystem development. *Maritime Economics & Logistics*, 17(1), 79-96. Http://dx.doi.org/10.1057/mel.2014.28

Homayouni, S., & Tang, S. (2015). Optimization of integrated scheduling of handling and storage operations at automated container terminals. *WMU Journal Of Maritime Affairs, 15*(1), 17-39. Http://dx.doi.org/10.1007/s13437-015-0089-x

Hong, Y., Chao, M., Yang, Y., & Rosner, J. (2010). Building and Testing Theories: Experiences from Conducting Social Identity Research. *Acta Psychologica Sinica, 42*(1), 22-36. http://dx.doi.org/10.3724/sp.j.1041.2010.00022

Horwitz, F. (2013). An analysis of skills development in a transitional economy: the case of the South African labour market. *The International Journal Of Human Resource Management*, *24*(12), 2435-2451. http://dx.doi.org/10.1080/09585192.2013.781438

Jang, D. (2009). Applications of R for Inferential Statistics in the Elementary Statistics Course. *Korean Journal Of Applied Statistics*, *22*(5), 893-910. Http://dx.doi.org/10.5351/kjas.2009.22.5.893

Jin, J., Gubbi, J., Marusic, S., & Palaniswami, M. (2014). An Information Framework for Creating a Smart City Through Internet of Things. *IEEE Internet Of Things Journal*, *1*(2), 112-121. Http://dx.doi.org/10.1109/jiot.2013.2296516

Johnston, A. (2014). Rigour in research: theory in the research approach. *European Business Review, 26*(3), 206-217. Http://dx.doi.org/10.1108/ebr-09-2013-0115

Jones, P. (2005). Maritime Transport Costs and Port Efficiency: A Historical Perspective. *SSRN Electronic Journal*. http://dx.doi.org/10.2139/ssrn.898468

Khan, Z., Anjum, A., Soomro, K., & Tahir, M. (2015). Towards cloud based big data analytics for smart future cities. *Journal Of Cloud Computing*, *4*(1). Http://dx.doi.org/10.1186/s13677-015-0026-8

Kim, D., Park, K., Choi, G., & Min, K. (2014). A study on the factors that affect the adoption of Smart Water Grid. *Journal Of Computer Virology And Hacking Techniques, 10*(2), 119-128. Http://dx.doi.org/10.1007/s11416-014-0206-y

Kim, S., Shin, D., Choe, Y., Seibert, T., & Walz, S. (2012). Integrated energy monitoring and visualization system for Smart Green City development. *Automation In Construction, 22,* 51-59. Http://dx.doi.org/10.1016/j.autcon.2011.07.004

Kitchin, R. (2013). The real-time city? Big data and smart urbanism. *Geojournal, 79*(1), 1-14. Http://dx.doi.org/10.1007/s10708-013-9516-8

Kitchin, R. (2014). Big Data, new epistemologies and paradigm shifts. *Big Data & Society, 1*(1). Http://dx.doi.org/10.1177/2053951714528481

Knotters, M., & Brus, D. (2012). Purposive versus random sampling for map validation: a case study on ecotope maps of floodplains in the Netherlands. *Ecohydrol., 6*(3), 425-434. Http://dx.doi.org/10.1002/eco.1289

Kolomitz, K., & Cabellon, E. (2016). A Strategic Necessity: Building Senior Leadership's Fluency in Digital Technology. *New Directions For Student Services, 2016*(155), 47-57. Http://dx.doi.org/10.1002/ss.20182

Kowalczyk, M., & Buxmann, P. (2015). An ambidextrous perspective on business intelligence and analytics support in decision processes: Insights from a multiple case study. *Decision Support Systems, 80,* 1-13. Http://dx.doi.org/10.1016/j.dss.2015.08.010

Kuan, K., & Chau, P. (2001). A perception-based model for EDI adoption in small businesses using a technology–organization–environment framework. *Information & Management, 38*(8), 507-521. http://dx.doi.org/10.1016/s0378-7206(01)00073-8

Kumar, S. (2016). Extracting Market Value of Business and Business Decision from Big Data Analytics. *International Journal Of Computer Applications*, *133*(1), 29-32. Http://dx.doi.org/10.5120/ijca2016907732

Lai, P. (2017). The literature review of technology adoption models and theories for the novelty technology. *Journal of information systems and technology management*, *14*(1). Http://dx.doi.org/10.4301/s1807-17752017000100002

Lameck, W. (2013). Sampling Design, Validity and Reliability in General Social Survey. *International Journal Of Academic Research In Business And Social Sciences*, *3*(7). Http://dx.doi.org/10.6007/ijarbss/v3-i7/27

Lee, J. (2013). A View Of Cloud Computing. *International Journal Of Networked And Distributed Computing*, *1*(1), 2. Http://dx.doi.org/10.2991/ijndc.2013.1.1.2

Lee, J., Kim, H., & Ahn, M. (2011). The willingness of e-Government service adoption by business users: The role of offline service quality and trust in technology. *Government Information Quarterly*, *28*(2), 222-230. Http://dx.doi.org/10.1016/j.giq.2010.07.007

Leedy, P., & Ormrod, J. (2005). Practical Research. Upper Saddle River: Prentice-Hall.

Li, X., Liao, J., Yuan, Y., & Yu, D. (2011). Eye-shaped segmented reader antenna for near-field uhf rfid applications. *Progress in Electromagnetics Research*, *114*, 481-493. Http://dx.doi.org/10.2528/pier11021601

Lokuge, P., & Alahakoon, D. (2007). Improving the adaptability in automated vessel scheduling in container ports using intelligent software agents. *European Journal Of Operational Research*, *177*(3), 1985-2015. Http://dx.doi.org/10.1016/j.ejor.2005.12.016

Low, C., Chen, Y., & Wu, M. (2011). Understanding the determinants of cloud computing adoption. *Industrial Management & Data Systems*, *111*(7), 1006-1023. Http://dx.doi.org/10.1108/02635571111161262

Lu, C., & Yang, C. (2012). Factors influencing the use intention of port logistics information system by ocean carriers. *International Journal Of Shipping And Transport Logistics*, *4*(1), 29. Http://dx.doi.org/10.1504/ijstl.2012.044134

Luo, L. (2010). Web 2.0 Integration in Information Literacy Instruction: An Overview. *The Journal Of Academic Librarianship*, *36*(1), 32-40. Http://dx.doi.org/10.1016/j.acalib.2009.11.004

Lushnikov, A. (2003). A critical analysis of the international terms of shipment in dry-bulk exports from the port of Richards bay. University of Natal.

Maspero, E., Van Dyk, E., & Ittmann, H. (2008). Maritime supply chain security: Navigating through a sea of compliance requirements. *Journal Of Transport And Supply Chain Management*, *2*(1). Http://dx.doi.org/10.4102/jtscm.v2i1.44

Maturana, F. (2004). Distributed multi-agent architecture for automation systems. *Expert Systems With Applications*, *26*(1), 49-56. Http://dx.doi.org/10.1016/s0957-4174(03)00068-x

Mielniczuk, J., & Teisseyre, P. (2014). Using random subspace method for prediction and variable importance assessment in linear regression. *Computational Statistics & Data Analysis*, *71*, 725-742. Http://dx.doi.org/10.1016/j.csda.2012.09.018

Mitton, N., Papavassiliou, S., Puliafito, A., & Trivedi, K. (2012). Combining Cloud and sensors in a smart city environment. *EURASIP J Wirel Commun Netw*, *2012*(1), 247. Http://dx.doi.org/10.1186/1687-1499-2012-247

Mokone, T. (2016). *The impact of governance structure on the port performance: a case of Durban Port* (Master of Science in Maritime Affairs Shipping Management and Logistics). World Maritime University.

Muravev, D., & Rakhmangulov, A. (2016). Environmental Factors' Consideration at Industrial Transportation Organization in the «Seaport – Dry port» System. *Open Engineering*, *6*(1). Http://dx.doi.org/10.1515/eng-2016-0070

Narsoo, J., A. Muslun, W., & Sameer Sunhaloo, M. (2009). A Radio Frequency Identification (RFID) Container Tracking System for Port Louis Harbor: The Case of Mauritius. *Issues In Informing Science And Information Technology*, *6*, 127-142. http://dx.doi.org/10.28945/1047

Ndlovu, Z. (2007). Port Infrastructure and Operational Efficiency, and Port Productivity Management. In *PMAESA Maritime Conference* (pp. 1-10). Mahe Seychelles: PMAESA. Retrieved from http://www.pmaesa.org/media/docs/Zeph_Ndlovu_TPT.pdf

Nguyen, T., & Aiello, M. (2013). Energy intelligent buildings based on user activity: A survey. *Energy And Building*s, 56, 244-257. Http://dx.doi.org/10.1016/j.enbuild.2012.09.005

Notteboom, T. (2016). The adaptive capacity of container ports in an era of mega vessels: The case of upstream seaports Antwerp and Hamburg. *Journal Of Transport Geography*, *54*, 295-309. Http://dx.doi.org/10.1016/j.jtrangeo.2016.06.002

Notteboom, T., & Winkelmans, W. (2001). Structural changes in logistics: how will port authorities face the challenge?. *Maritime Policy & Management*, *28*(1), 71-89. Http://dx.doi.org/10.1080/03088830119197

Oliveira, T., Thomas, M., & Espadanal, M. (2014). Assessing the determinants of cloud computing adoption: An analysis of the manufacturing and services sectors. *Information & Management*, *51*(5), 497-510. http://dx.doi.org/10.1016/j.im.2014.03.006

Ortiz, A., Hussein, D., Park, S., Han, S., & Crespi, N. (2014). The Cluster Between Internet of Things and Social Networks: Review and Research Challenges. *IEEE Internet Of Things Journal*, *1*(3), 206-215. Http://dx.doi.org/10.1109/jiot.2014.2318835

Pallis, A., & de Langen, P. (2010). Seaports and the structural implications of the economic crisis. *Research In Transportation Economics*, 27(1), 10-18. Http://dx.doi.org/10.1016/j.retrec.2009.12.003

Perera, C., Zaslavsky, A., Christen, P., & Georgakopoulos, D. (2013). Sensing as a service model for smart cities supported by Internet of Things. *Transactions On Emerging Telecommunications Technologies*, *25*(1), 81-93. Http://dx.doi.org/10.1002/ett.2704

Pérez, I., Trujillo, L., & González, M. (2016). Efficiency determinants of container terminals in Latin American and the Caribbean. *Utilities Policy*, *41*, 1-14. Http://dx.doi.org/10.1016/j.jup.2015.12.001

Pestana Barros, C. (2012). Productivity Assessment of African Seaports. *African Development Review*, *24*(1), 67-78. Http://dx.doi.org/10.1111/j.1467-8268.2011.00305.x

Pettit, S., & Beresford, A. (2009). Port development: from gateways to logistics hubs. *Maritime Policy & Management*, *36*(3), 253-267. Http://dx.doi.org/10.1080/03088830902861144

Picoto, W., Bélanger, F., & Reis, A. (2014). A technology-organisation-environment (TOE)-based m-business value instrument. *International Journal Of Mobile Communications*, *12*(1), 78. Http://dx.doi.org/10.1504/ijmc.2014.059240

Poba-Nzaou, P., & Raymond, L. (2013). Custom Development as an Alternative for ERP Adoption by SMES: An Interpretive Case Study. *Information Systems Management*, *30*(4), 319-335. Http://dx.doi.org/10.1080/10580530.2013.832963

Racherla, P., & Hu, C. (2008). eCRM System Adoption by Hospitality Organizations: A Technology-Organization-Environment (TOE) Framework. *Journal Of Hospitality & Leisure Marketing, 17(1-2), 30-58.* http://dx.doi.org/10.1080/10507050801978372

Rahayu, R., & Day, J. (2015). Determinant Factors of E-commerce Adoption by SMEs in Developing Country: Evidence from Indonesia. *Procedia - Social And Behavioral Sciences*, *195*, 142-150. http://dx.doi.org/10.1016/j.sbspro.2015.06.423

Rekleitis, E., Rizomiliotis, P., & Gritzalis, S. (2011). How to protect security and privacy in the iot: a policy-based RFID tag management protocol. *Security And Communication Networks*, *7*(12), 2669-2683. Http://dx.doi.org/10.1002/sec.400

Role of Big Data and Analytics in Smart Cities. (2016). *International Journal Of Science And Research (IJSR)*, *5*(2), 12-23. Http://dx.doi.org/10.21275/v5i2.nov161007

Roso, V., Woxenius, J., & Lumsden, K. (2009). The dry port concept: connecting container seaports with the hinterland. *Journal Of Transport Geography*, *17*(5), 338-345. Http://dx.doi.org/10.1016/j.jtrangeo.2008.10.008

Saha, D., & Mukherjee, A. (2003). Pervasive computing: a paradigm for the 21st century. *Computer*, *36*(3), 25-31. Http://dx.doi.org/10.1109/mc.2003.1185214

Sanaei, Z., Abolfazli, S., Gani, A., & Buyya, R. (2014). Heterogeneity in Mobile Cloud Computing: Taxonomy and Open Challenges. *IEEE Communications Surveys & Tutorials*, *16*(1), 369-392. Http://dx.doi.org/10.1109/surv.2013.050113.00090

Saunders, J., Wong, V., & Saunders, C. (2011). The Research Evaluation and Globalization of Business Research. *British Journal Of Management*, *22*(3), 401-419. Http://dx.doi.org/10.1111/j.1467-8551.2011.00755.x

Saunders, M., Lewis, P., & Thornhill, A. (2009). Research methods for business students (5th ed., p. 108). Harlow: Financial Times Prentice Hall.

Saunders, M., Lewis, P., & Thornhill, A. (2009). Research methods for business students (5th ed., p. 152). Harlow: Financial Times Prentice Hall.

Sekaran, U., & Bougie, R. (2016). Research methods for business. New York: Wiley.

Shah, G., Annappa, A., & Shet, K. (2014). Design an Efficient Big Data Analytic Architecture for Retrieval of Data Based on Web Server in Cloud Environment. *International Journal On Cloud Computing: Services And Architecture, 4*(2), 1-10. Http://dx.doi.org/10.5121/ijccsa.2014.4201

Shah, N., & Ghulam Sarwar Shah, S. (2010). Relationships between employee readiness for organisational change, supervisor and peer relations and demography. *Journal Of Ent Info Management*, *23*(5), 640-652. Http://dx.doi.org/10.1108/17410391011083074

Shi, P., & Yan, B. (2016). Factors affecting RFID adoption in the agricultural product distribution industry: empirical evidence from China. *Springerplus, 5*(1). Http://dx.doi.org/10.1186/s40064-016-3708-x

Shi, X., Tao, D., & Voß, S. (2011). RFID Technology and its Application to Port-Based Container Logistics. *Journal Of Organizational Computing And Electronic Commerce*, *21*(4), 332-347. http://dx.doi.org/10.1080/10919392.2011.614202

Simmhan, Y., Aman, S., Kumbhare, A., Liu, R., Stevens, S., Zhou, Q., & Prasanna, V. (2013). Cloud-Based Software Platform for Big Data Analytics in Smart Grids. *Comput. Sci. Eng.*, *15*(4), 38-47. Http://dx.doi.org/10.1109/mcse.2013.39

Sobh, R., & Perry, C. (2006). Research design and data analysis in realism research. *European Journal Of Marketing*, *40*(11/12), 1194-1209. Http://dx.doi.org/10.1108/03090560610702777

Son, M., & Han, K. (2011). Beyond the technology adoption: Technology readiness effects on post-adoption behavior. *Journal Of Business Research*, *64*(11), 1178-1182. Http://dx.doi.org/10.1016/j.jbusres.2011.06.019

Suykens, F. (1983). A Few observations on productivity in seaports. *Maritime Policy & Management, 10*(1), 17-40. Http://dx.doi.org/10.1080/03088838300000002

Swaminathan, R. (2015). Ports and Digital Ports: The Narrative Construction and Social Imaginaries of the Island City of Mumbai. *Urban Island Studies, 1*, 35-54. Http://dx.doi.org/10.20958/uis.2015.3

Syväjärvi, A., Kivivirta, V., Stenvall, J., & Laitinen, I. (2015). Digitalization and Information Management in Smart City Government:. *International Journal Of Innovation In The Digital Economy, 6*(4), 1-15. Http://dx.doi.org/10.4018/ijide.2015100101

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal Of Medical Education, 2*, 53-55. http://dx.doi.org/10.5116/ijme.4dfb.8dfd

Tien, J. (2013). Big Data: Unleashing information. *J. Syst. Sci. Syst. Eng.*, *22*(2), 127-151. Http://dx.doi.org/10.1007/s11518-013-5219-4

Tongzon, J. (2001). Efficiency measurement of selected Australian and other international ports using data envelopment analysis. *Transportation Research Part A: Policy And Practice, 35*(2), 107-122. Http://dx.doi.org/10.1016/s0965-8564(99)00049-x

Tongzon, J., & Heng, W. (2005). Port privatization, efficiency and competitiveness: Some empirical evidence from container ports (terminals). *Transportation Research Part A: Policy And Practice, 39*(5), 405-424. Http://dx.doi.org/10.1016/j.tra.2005.02.001

Trujillo, L., González, M., & Jiménez, J. (2013). An overview on the reform process of African ports. *Utilities Policy, 25*, 12-22. Http://dx.doi.org/10.1016/j.jup.2013.01.002

Van Velzen, J. (2016). Students General Knowledge of the Learning Process: A Mixed Methods Study Illustrating Integrated Data Collection and Data Consolidation. *Journal Of Mixed Methods Research*. Http://dx.doi.org/10.1177/1558689816651792

Verhoeven, P. (2010). A review of port authority functions: towards a renaissance?. *Maritime Policy & Management*, *37*(3), 247-270. Http://dx.doi.org/10.1080/03088831003700645

Vhumbunu, C. (2016). Enabling African Regional Infrastructure Renaissance through the China-Africa Partnership: A Trans-Continental Appraisal. *International Journal Of China Studies African*, *7*(3), 271-300.

Wang, Y., Wang, Y., & Yang, Y. (2010). Understanding the determinants of RFID adoption in the manufacturing industry. *Technological Forecasting And Social Change*, 77(5), 803-815. Http://dx.doi.org/10.1016/j.techfore.2010.03.006

Wu, I., & Chen, J. (2005). An extension of Trust and TAM model with TPB in the initial adoption of on-line tax: An empirical study. *International Journal Of Human-Computer Studies*, *62*(6), 784-808. Http://dx.doi.org/10.1016/j.ijhcs.2005.03.003

Yousafzai, S., & Yani-de-Soriano, M. (2012). Understanding customer-specific factors underpinning internet banking adoption. *International Journal Of Bank Marketing*, *30*(1), 60-81. Http://dx.doi.org/10.1108/02652321211195703

Yu, C., & Tao, Y. (2009). Understanding business-level innovation technology adoption. *Technovation*, *29*(2), 92-109. Http://dx.doi.org/10.1016/j.technovation.2008.07.007

Yu, M., & Qi, X. (2013). Storage space allocation models for inbound containers in an automatic container terminal. *European Journal Of Operational Research*, 226(1), 32-45. Http://dx.doi.org/10.1016/j.ejor.2012.10.045

Zanella, A., Bui, N., Castellani, A., Vangelista, L., & Zorzi, M. (2014). Internet of Things for Smart Cities. *IEEE Internet Of Things Journal*, *1*(1), 22-32. Http://dx.doi.org/10.1109/jiot.2014.2306328

Zavadskas, E., Turskis, Z., & Bagočius, V. (2015). Multi-criteria selection of a deep-water port in the Eastern Baltic Sea. *Applied Soft Computing*, *26*, 180-192. Http://dx.doi.org/10.1016/j.asoc.2014.09.019

Zehendner, E., & Feillet, D. (2014). Benefits of a truck appointment system on the service quality of inland transport modes at a multimodal container terminal. *European Journal Of Operational Research*, *235*(2), 461-469. Http://dx.doi.org/10.1016/j.ejor.2013.07.005

Zhang, J., Wang, F., Wang, K., Lin, W., Xu, X., & Chen, C. (2011). Data-Driven Intelligent Transportation Systems: A Survey. *IEEE Transactions On Intelligent Transportation Systems*, *12*(4), 1624-1639. Http://dx.doi.org/10.1109/tits.2011.2158001

Zhao, L., Tian, L., Cai, T., Claggett, B., & Wei, L. (2013). Effectively Selecting a Target Population for a Future Comparative Study. *Journal Of The American Statistical Association*, 108(502), 527-539. Http://dx.doi.org/10.1080/01621459.2013.770705

Zhou, J. (2013). Digitalization and intelligentization of manufacturing industry. *Advances In Manufacturing*, *1*(1), 1-7. Http://dx.doi.org/10.1007/s40436-013-0006-5

Zhu, K., & Kraemer, K. (2005). Post-Adoption Variations in Usage and Value of E-Business by Organizations: Cross-Country Evidence from the Retail Industry. *Information Systems Research*, *16*(1), 61-84. http://dx.doi.org/10.1287/isre.1050.0045

Zhu, K., & Kraemer, K. (2005). Post-Adoption Variations in Usage and Value of E-Business by Organizations: Cross-Country Evidence from the Retail Industry. *Information Systems Research*, *16*(1), 61-84. http://dx.doi.org/10.1287/isre.1050.0045

Ziegeldorf, J., Morchon, O., & Wehrle, K. (2013). Privacy in the Internet of Things: threats and challenges. *Security And Communication Networks*, 7(12), 2728-2742. Http://dx.doi.org/10.1002/sec.795

APPENDIX A: ETHICAL CLEARANCE

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

20 September 2016

Mr John Mukomana (215081007)
School of Management, IT & Governance
Westville Campus

Dear Mr Mukomana,

Protocol reference number: HSS/1393/016M
Project title: Adoption of an Intelligent Port Terminal: A case study of Port Terminals in Durban

Full Approval – Expedited Application

In response to your application received on 19 August 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 Shamila Naidoo (Deputy Chair)

/ms

Cc Supervisor: Dr Indira Padayachee
Cc Academic Leader Research: Professor Brian McArthur
Cc School Administrator: Ms Angela Pearce

Humanities & Social Sciences Research Ethics Committee
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APPENDIX B: INFORMED CONSENT FORM

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

College of Law and Management Studies
School of Management, Information Technology and Governance

Informed Consent for Research Participation

Title of the study	:	**Adoption of an Intelligent Port Terminal: A case stud of Port Terminals in Durban.**
Name of researcher	:	**Mr John Mukomana**
Contact details	:	✉ 031 361 2283 071 544 0348
Name of supervisor	:	**Dr Indira Padayachee**
Contact details	:	✉ Padayacheei@ukzn.ac.za 031 260 3525
HSSREC Research Office	:	**University of KwaZulu-Natal, Westville Campus.**
HSSREC Administrator	:	**Ms Mariette Snyman**
Contact details	:	✉ snymanm@ukzn.ac.za 031 260 8350 031 260 3093

I [<<*insert name*>>] in my capacity as [<<*insert position in company*>>] at give consent in principle to allow John Mukomana, a student at the University of Kwa-Zulu Natal, to collect data from me as part of his Mcom in Information Systems & Technology (Mcom ISTN) research. The student has explained to me the nature of his research and the nature of the data to be collected.

Respondent: I was informed by the researcher (Mr John Mukomana) that I have the right to stop participating on the survey at any time if I feel uncomfortable with the questions asked.

Confidentiality: The researcher assured me that the data collected from me during the survey process will be securely stored and protected and not discussed with any colleagues.

Voluntary Participation: I am not obligated to respond to this study and if I decide to respond, I reserve the right to withdraw this permission at any time.

Additional consent: Please tick below

Data collected during the survey may be used for....	Thesis	Conference paper	Journal article	Research poster
Yes			☐	
No			☐	

Respondent's signature: _____ Date: _____

Researcher's signature: _____ Date: _____

APPENDIX C: QUESTIONNAIRE

Dear Colleague

My Name is **John Mukomana** a Governance, Risk and Compliance Officer

I am also a student at The **University of KwaZulu-Natal (UKZN)** studying towards attaining a **Master of Commerce in Information Systems and Technology (Mcom ISTN)** degree. As part of my studies I am required to conduct a research in the field related to my study and this survey is part of the research.

The title of my research is: **"Adoption of an Intelligent Port Terminal: A case study of Port Terminals in Durban"**. My Supervisor is **Dr Indira Padayachee** the Academic Leader: Teaching & Learning in the School of Management, Information Technology and Governance, College of Law & Management Studies at UKZN.

An **Intelligent Port Terminal** is defined in this research as a fully automated port where all devices are connected via the so-called Internet of Things, the major drivers in an intelligent port are productivity and efficiency gains, The effectiveness of the intelligent port environment may lie in the technology and smart practices ability to be able to work together to effectively share information, both for the benefit of the port and for its customers.

Your willingness to voluntarily participate in this survey is greatly appreciated and contributes to the creation of new knowledge.

The Survey consists of 6 sections listed below

1. Section A: - Demographics.
2. Section B: - Technological Factors.
3. Section C: - Organisation Factors.
4. Section D: - Environmental Factors.
5. Section E: - Adoption of an Intelligent Port.
6. Section F: - Challenges and limitations in Port Operations.

It will take about 15-20minutes of your time to complete this survey, participation in this survey is completely voluntary. All information provided through your participation in this survey will be kept confidential, you will not be identified in the dissertation or in any report on this research. There are no known or anticipated risks for participating in this study. The data collected through this study will be kept for a period of five years in a secure location.

Please email this survey directly to me

Thank you in advance for participating in my research.

Yours sincerely

ADOPTION OF AN INTELLIGENT PORT TERMINAL SURVEY

SECTION A: - DEMOGRAPHICS

Please place a cross (X) in the second column to choose an option.

Note that only ONE option should be selected per question and only the option column is editable.

A1. What age group do you belong to?	**Choose One Option**
< 25 years	
25 – 29 years	
30 – 39 years	
40 – 49 years	
> 49 years	
A2. Which section in the EIMS Department do you work in?	**Choose One Option**
Service Delivery	
Office of the CIO	
Business Enablement	
Value Creation	
Sustainability	
A3. Which position level are you within the business?	**Choose One Option**
Junior Level (**Level G and below**)	
Junior Manager (**Level F**)	
Middle Manager (**Level E**)	
Senior Manager (**Level D**)	
General Manager(**Level B**)	
A4. What is your highest level of qualification?	**Choose One Option**
Matric	
Technical or National Diploma	
Degree	
Post graduate Degree (Honours or Equivalent)	
Masters	
Doctorate	
A5. What is the range of your experience of working in ICT?	**Choose One Option**
<1 years	
1 – 4 years	
5 – 9 years	
10 – 14 years	
14 – 19 years	
20+ years	
A6. What is the range of your experience of working in Port Operations?	**Choose One Option**
<1 years	
1 – 4 years	
5 – 9 years	
10 – 14 years	
14 – 19 years	
20+ years	

ADOPTION OF AN INTELLIGENT PORT TERMINAL SURVEY

SECTION B: TECHNOLOGICAL FACTORS

Indicate your agreement with the following statements.

Opinion	Ratings				
B1: Technology Availability	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
B1.1 The internet of things (RFID & LTE) to fully automate port terminal operations is already available in the organization.	☐	☐	☐	☐	☐
B1.2 Big data (Data analytics tools) to fully automate port terminal operations are already available in the organization.	☐	☐	☐	☐	☐
B1.3 Data visualisation (Business Intelligence) tools to fully automate port terminal operations are already available in the organization.	☐	☐	☐	☐	☐
B1.4 Cloud Computing capabilities to fully automate port terminal operations are already available to the organization.	☐	☐	☐	☐	☐
B1.5 Pervasive Computing (Sensor's) to fully automate port terminal operations is already available in the organization.	☐	☐	☐	☐	☐
B1.6 Latest advances in information security mechanisms to enable full automation of port terminal operations are already available in the organization.	☐	☐	☐	☐	☐
B2: Technology Competence(Perceived compatibility)	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
B2.1 The computer hardware (PC's, Servers, Printers & Scanners) being utilized by the organization is compatible to use for entirely automating the port operations.	☐	☐	☐	☐	☐
B2.2 The computer network (UTP, Optic fibre & WIFI) being utilized by the organization is compatible to use for entirely automating the port operations.	☐	☐	☐	☐	☐
B2.3 The computer systems (SAP, GCOS & NAVIS) being utilized by the organization are compatible to use for entirely automating the port operations.	☐	☐	☐	☐	☐
B2.4 The technology (Computer hardware, Network's & Systems) in use is well integrated to enable the entire automation of port operations.	☐	☐	☐	☐	☐
B3: Technology complexity (Perceived Complexity/serviceability)	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
B3.1 The technology being utilised by the organisation is easy and simple to use.	☐	☐	☐	☐	☐
B3.2 The technology being used by the organisation is easy to implement.	☐	☐	☐	☐	☐
B3.3 The technology being used by the organisation is easy to maintain.	☐	☐	☐	☐	☐
B3.4 The technology being used by the organisation can be easily integrated with other computer systems (e.g. from Traffic department, Shipping agents and weather monitoring companies).	☐	☐	☐	☐	☐

SECTION B: TECHNOLOGICAL FACTORS (*Continued*)

Indicate your agreement with the following statements.

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Opinion	Ratings				
B4: Data & Information security	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
B4.1 The company's data and information security mechanisms are capable of preventing any unauthorised computer system access.	☐	☐	☐	☐	☐
B4.2 The company's data and information security mechanisms are capable of preserving privacy of the company's records.	☐	☐	☐	☐	☐
B4.3 The company's data and information security mechanisms are capable of preserving integrity of the company's records.	☐	☐	☐	☐	☐
B5: Perceived benefits	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
B5.1 The technology being utilised by the organisation is able to achieve the required operational efficiency.	☐	☐	☐	☐	☐
B5.2 The technology being utilised by the organisation is able to achieve the required service quality & consistency.	☐	☐	☐	☐	☐
B5.3 The technology being utilised by the organisation is able to achieve the required operational turnaround times.	☐	☐	☐	☐	☐
B5.4 The technology being utilised by the organisation is able to achieve the required operational costs.	☐	☐	☐	☐	☐
B5.5 The technology being utilised by the organisation is able to achieve the required operational audit trails (accountability).	☐	☐	☐	☐	☐

SECTION C: ORGANISATIONAL FACTORS

Indicate your agreement with the following statements.

Opinion	Ratings				
C1: Organisational Structure (Culture & Size)	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
C1.1 The number of EIMS employees in the organisation is adequate for maintaining the port operations.	☐	☐	☐	☐	☐
C1.2 The EIMS structural positions (IT Technicians, Project Managers, Architects, etc.) in the organisation are suitable for maintaining port operations.	☐	☐	☐	☐	☐
C1.3 The EIMS department functional setup (Service delivery, Office of the CIO, Project Management, etc.) is suitable for maintaining the port operations.	☐	☐	☐	☐	☐
C1.4 The EIMS operational processes (Policies, Procedure, Standards, etc.) are suitable for maintaining the port operations.	☐	☐	☐	☐	☐

ADOPTION OF AN INTELLIGENT PORT TERMINAL SURVEY

SECTION C: ORGANISATIONAL FACTORS (*Continued*)

Indicate your agreement with the following statements.

Opinion	Ratings				
C2: Communication process (Organisational Change)	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
C2.1 The communication process (top-down approach) is effective for running IT operations in the organisation.	☐	☐	☐	☐	☐
C2.2 The communication methods/tools (email & meetings, etc.) are effective for running IT operations in the organisation.	☐	☐	☐	☐	☐
C2.3 The organisation clearly communicates its strategies and goals to all stakeholders.	☐	☐	☐	☐	☐
C3: IT Skills (Adaptability of employees)	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
C3.1 The organisation employees have the technical skills (Programming, Database management, etc.) required to implement IT Solutions.	☐	☐	☐	☐	☐
C3.2 The organisation employees have the technical skills (Programming, Database management, etc.) required to maintain IT Solutions.	☐	☐	☐	☐	☐
C3.3 The organisation employees have the data analytics skills (Business analysis, IT Architecture, etc.) required to implement IT Solutions.	☐	☐	☐	☐	☐
C3.4 The organisation employees have the data analytics skills (Business analysis, IT Architecture, etc.) required to maintain IT Solutions.	☐	☐	☐	☐	☐
C3.5 The organisation employees have the decision making skills (intuition, reasoning, etc.) required to implement IT Solutions.	☐	☐	☐	☐	☐
C3.6 The organisation employees have the decision making skills (intuition, reasoning, etc.) required to maintain IT Solutions.	☐	☐	☐	☐	☐
C4: Top management support	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
C4.1 Top management clearly explains the vision being followed by the organisation to employees.	☐	☐	☐	☐	☐
C4.2 Top management is positively involved in activities to improve operational productivity.	☐	☐	☐	☐	☐
C4.3 Top management provides financial support when operational systems are being changed.	☐	☐	☐	☐	☐
C4.4 Top management provides enough resources when operational systems are being changed.	☐	☐	☐	☐	☐
C4.5 Top management is always willing to embrace change in operational computer systems.	☐	☐	☐	☐	☐
C5: Organisational Goals	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
C5.1 The organisation is growing its market share (Revenue).	☐	☐	☐	☐	☐
C5.2 The organisation's IT Terminal operations are being efficiently run (Productively).	☐	☐	☐	☐	☐
C5.3 The organisation has a good operational reputation in the industry (Good standing reputation).	☐	☐	☐	☐	☐
C5.4 The organisation's customers are satisfied with the service being given (Customer satisfaction).	☐	☐	☐	☐	☐

ADOPTION OF AN INTELLIGENT PORT TERMINAL SURVEY

SECTION D: ENVIRONMENTAL FACTORS

Indicate your agreement with the following statements.

Opinion	Ratings				
D1: Competitive pressure	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
D1.1 Pressure from competitors ensures the company strives to perform better on the market than its competitors.	☐	☐	☐	☐	☐
D1.2 Pressure from competitors ensures the company strives to keep improving its performance.	☐	☐	☐	☐	☐
D1.3 Pressure from competitors ensures the company strives to have a relative advantage over its competitors.	☐	☐	☐	☐	☐
D1.2 Pressure from competitors ensures the company strives to remain competitive in the market.	☐	☐	☐	☐	☐
D2: Laws and regulations	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
D2.1 The organisation's operations adhere to the Electronic Communications and Transactions Act No.25 of 2002.	☐	☐	☐	☐	☐
D2.2 The organisation's operations adhere to Regulation of Interception of Communications and Provision of Communication Related Information Act No. 70 of 2002.	☐	☐	☐	☐	☐
D2.3 The organisation's operations adhere to King Code on Corporate Governance III.	☐	☐	☐	☐	☐
D2.4 The organisation's operations adhere to Independent Communications Authority of South Africa Act of 2000.	☐	☐	☐	☐	☐
D2.5 The organisation's operations adhere to the Copyright Act, 1978 (Act No. 98 of 1978).	☐	☐	☐	☐	☐
D2.6 The organisation's operations adhere to the Protection of Personal Information Act, 2013 (Act No 4 of 2013.)	☐	☐	☐	☐	☐
D3: Customer Readiness (Customer systems, processes)	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
D3.1 Customers' computer systems are well integrated with our port terminal operations systems.	☐	☐	☐	☐	☐
D3.2 Customers' operating processes are ready for the full automation of port terminal processes.	☐	☐	☐	☐	☐
D3.3 Customers are well informed about our business processes.	☐	☐	☐	☐	☐
D3.4 Customers are cooperative when system transition takes place.	☐	☐	☐	☐	☐

ADOPTION OF AN INTELLIGENT PORT TERMINAL SURVEY

SECTION D: ENVIRONMENTAL FACTORS (*Continued*)

Indicate your agreement with the following statements.

Opinion	Ratings				
D4: Trading partners influence (.e.g. Shipping agencies & trucking companies)	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
D4.1 Stakeholders (e.g. shipping agencies, trucking companies) are able to access information regarding the transportation of their goods online.	☐	☐	☐	☐	☐
D4.2 Stakeholders (e.g. shipping agencies, trucking companies) are able to make quicker decisions by instantly accessing information from our systems online.	☐	☐	☐	☐	☐
D4.3 Stakeholders (e.g. shipping agencies, trucking companies) can save costs through shorter turnaround times at port terminals.	☐	☐	☐	☐	☐
D4.4 Information accuracy is maintained when information is transferred between the company's systems and the stakeholders (e.g. shipping agencies, trucking companies) systems.	☐	☐	☐	☐	☐

SECTION E: ADOPTION OF AN INTELLIGENT PORT

Indicate your agreement with the following statements.

Opinion	Ratings				
E: ADOPTION OF AN INTELLIGENT PORT	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
E1 I think the organisation is ready to fully automate its port terminal operations.	☐	☐	☐	☐	☐
E2 I think the organisation has the capability to fully automate its port terminal operations.	☐	☐	☐	☐	☐
E3 I think the organisation will successfully automate its entire port terminal operations.	☐	☐	☐	☐	☐

ADOPTION OF AN INTELLIGENT PORT TERMINAL SURVEY

SECTION F: CHALLENGES AND LIMITATIONS EXPERIENCED IN PORT TERMINAL OPERATIONS

Indicate your agreement with the following statements.

Opinion	Ratings				
F1: CHALLENGES AND LIMITATIONS EXPERIENCED IN PORT TERMINAL OPERATIONS	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
F1.1 IT infrastructure (Hardware & Networks) to run port terminal operations is sufficient.	☐	☐	☐	☐	☐
F1.2 Computer Systems (SAP, GCOS & Navis) are adequate for port terminal operations.	☐	☐	☐	☐	☐
F1.3 Financial support is adequate to maintain and upgrade terminal operations infrastructure and systems.	☐	☐	☐	☐	☐
F1.4 IT Employees are skilled enough to run port terminal operations efficiently.	☐	☐	☐	☐	☐
F1.5 Top management support is sufficient to enable port terminal operations to be run effectively.	☐	☐	☐	☐	☐
F1.6 Information (Data analytics & Business intelligence) to make the correct decisions regarding port terminal operations is available.	☐	☐	☐	☐	☐
F1.7 Labour (Labour unions and employee committees) are in support of fully automating port operations.	☐	☐	☐	☐	☐

F2. What other technologies should the organisation implement to reduce the challenges and limitations being experienced in port terminal operations?

F3. What other organisational issues should be taken into consideration for improving the efficiency and productivity of the port terminal operations?

F4. What other environmental issues should be taken into consideration by improving efficiency and productivity through automating port terminal operations?

THE END

APPENDIX D: SAMPLE SIZE TABLE

POPULATION TO SAMPLE SIZE TABLE

N	S	N	S	N	S
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10 000	370
150	108	750	254	14 000	375
160	113	800	260	20 000	377
170	118	850	265	30 000	379
180	123	900	269	40 000	380
190	127	950	274	50 000	381
200	132	1000	278	75 000	382
210	136	1100	285	1 000 000	384

(Krejcie and Morgan (1970))

APPENDIX E: REGRESSION ANALYSIS

Dependent Variable: Adoption

Independent variable: Influence of technological factors

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.793[a]	.629	.591	.63370

a. Predictors: (Constant), Benefits, Availability, Compatibility, Security, Complexity

b. Dependent Variable: Adoption

Table 6.1: Model Summary [Influence of technological factors on adoption]

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	33.983	5	6.797	16.924	.000[a]
	Residual	20.079	50	.402		
	Total	54.062	55			

a. Predictors: (Constant), Benefits, Availability, Compatibility, Security, Complexity

b. Dependent Variable: Adoption

Table 6.2: ANOVA [Influence of technological factors on adoption]

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
1 (Constant)	-.345	.477		-.723	.473		
Availability	.233	.128	.181	1.827	.074	.756	1.322
Compatibility	.321	.132	.291	2.434	.019	.518	1.931
Complexity	.662	.165	.532	4.020	.000	.425	2.354
Security	-.223	.154	-.172	-1.450	.153	.527	1.897
Benefits	.124	.140	.104	.886	.380	.539	1.856

a. Dependent Variable: Adoption

Table 6.3: Coefficients [Influence of technological factors on adoption]

Dependent Variable: Adoption

Independent variable: Influence of organisational factors

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.745[a]	.555	.511	.69337

a. Predictors: (Constant), Organisational goals, IT skills, Structure, Top Management Support, Communication

b. Dependent Variable: Adoption

Table 6.4: Model summary [Influence of organisational factors on adoption]

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	30.024	5	6.005	12.490	.000[a]
	Residual	24.038	50	.481		
	Total	54.062	55			

a. Predictors: (Constant), Organisational goals, IT skills, Structure, Top Management Support, Communication

b. Dependent Variable: Adoption

Table 6.5: ANOVA [Influence of organisational factors on adoption]

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.601	.421		1.429	.159		
	Structure	-.133	.183	-.122	-.728	.470	.317	3.151
	Communication	.505	.183	.498	2.761	.008	.274	3.656
	IT skills	.384	.117	.380	3.287	.002	.664	1.506
	Top management support	.215	.177	.192	1.221	.228	.361	2.771
	Organisational goals	-.171	.145	-.138	-1.180	.243	.650	1.538

a. Dependent Variable: Adoption

Table 6.6: Coefficients [Influence of organisational factors on adoption]

Dependent Variable: Adoption

Independent variable: Influence of environmental factors

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.702[a]	.492	.452	.73370

a. Predictors: (Constant), Trading partners influence, Laws and regulations, Competitive pressure, Customer readiness

b. Dependent Variable: Adoption

Table 6.7: Model summary [Influence of environmental factors on adoption]

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	26.607	4	6.652	12.357	.000[a]
	Residual	27.454	51	.538		
	Total	54.062	55			

a. Predictors: (Constant), Trading partners influence, Laws and regulations, Competitive pressure, Customer readiness

b. Dependent Variable: Adoption

Table 6.8: ANOVA [Influence of environmental factors on adoption]

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.111	.607		.183	.856		
	Competitive pressure	-.010	.135	-.010	-.071	.944	.530	1.885
	Laws and regulations	.089	.184	.058	.486	.629	.687	1.455
	Customer readiness	.676	.180	.552	3.753	.000	.460	2.175
	Trading partners influence	.191	.162	.171	1.176	.245	.469	2.131

a. Dependent Variable: Adoption

Table 6.9: Coefficients [Influence of environmental factors on adoption]

APPENDIX F: THE ONE SAMPLE *T*-TEST

Technological factors

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
B1	56	2.6042	.76973	.10286
B2	56	3.2634	.90002	.12027
B3	56	3.4598	.79598	.10637
B4	56	3.7083	.76558	.10230
B5	56	3.5821	.82970	.11087

One-Sample Test

	Test Value = 3					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
B1	-3.848	55	.000	-.39583	-.6020	-.1897
B2	2.190	55	.033	.26339	.0224	.5044
B3	4.323	55	.000	.45982	.2467	.6730
B4	6.924	55	.000	.70833	.5033	.9134
B5	5.251	55	.000	.58214	.3599	.8043

Organisational factors

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
C1	56	2.9911	.90574	.12104
C2	56	3.1607	.97647	.13049
C3	56	3.3155	.98251	.13129
C4	56	3.0107	.88167	.11782
C5	56	2.9286	.80016	.10693

One-Sample Test

	Test Value = 3					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
C1	-.074	55	.941	-.00893	-.2515	.2336
C2	1.232	55	.223	.16071	-.1008	.4222
C3	2.403	55	.020	.31548	.0524	.5786
C4	.091	55	.928	.01071	-.2254	.2468
C5	-.668	55	.507	-.07143	-.2857	.1429

Environmental factors

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
D1	56	3.3482	1.00981	.13494
D2	56	3.5268	.64883	.08670
D3	56	3.2098	.81013	.10826
D4	56	3.4420	.89060	.11901

One-Sample Test

	Test Value = 3					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
D1	2.580	55	.013	.34821	.0778	.6186
D2	6.076	55	.000	.52679	.3530	.7005
D3	1.938	55	.058	.20982	-.0071	.4268
D4	3.714	55	.000	.44196	.2035	.6805

APPENDIX G: STATISTICIAN

Gill Hendry B.Sc. (Hons), M.Sc. (Wits), PhD (UKZN)
Mathematical and Statistical Services

Cell: 083 300 9896
email : hendryfam@telkomsa.net

11 July 2017

Re: Assistance with statistical analysis

Please be advised that I have assisted John Mukomana (Student number 215081007), who is presently studying for a Masters of Commerce in Information Systems and Technology (MCom ISTN) at UKZN, with the statistical analysis for his study.

Yours sincerely

Gill Hendry (Dr)