The role of logistics in enhancing competitive advantage in global logistics organization

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Declaration

I, Zwelakhe Mduduzi Mashinini (820411000), hereby declare that this mini-dissertation under the topic “The role of logistics in enhancing competitive advantage in global logistics organization, is a presentation of my own work. I have composed it in my own capacity with the assistance from my supervisor, Prof. Arnesh Telukdarie. This paper has not been submitted to any higher learning institution in an application of any professional qualification.

Abstract

Customer demands and increased competition create significant complexity for logistics organizations. Global logistics organizations are seeking the advantage of cost management, increased productivity and competitiveness. Companies that want to remain in business have to respond strategically and to fulfill the needs of customers.

The objectives of the study are to determine the role of logistics in a global organization and to determine the relationship between applying continuous improvement and adoption of technology in enhancing competitive advantage in logistics. The study commences with a literature review to explore improvement methodologies and the adoption of information technology in logistics. The literature study discussed Value Stream Mapping as a lean tool and simulation as a tool to aid in decision making. The study narrowed to the warehouse operation of a global logistics organization.

The researcher utilized a case study of a warehouse operation to identify and examine the process flow that exists within the operation. In this study, the target is to reduce the cycle times and observe the impact on the performance output. Historical data is collected from the Warehouse Management System, and additional data via observations. The value chain of the warehouse is rendered as a current state Value Stream Map describing the flow of operations. The Value Stream Map and the sample data is then used to configure a simulation model using Anylogic 8.5.1 University Researcher Edition.

The results of the simulation illustrate that if continuous improvement methodologies are implemented with technology, the warehouse operation performance improves. The simulation experiment illustrates how the installation of Smart Logistics Zones (SLZ) improves the performance of the warehouse.

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List of Acronym Definitions

Key Term or Acronym	Definition
AGV'S	Automated Guided Vehicles
RFID	Radio Frequency Identification
EDI	Electronic Data Interchange
IT	Information Technology
AR	Augmented Reality
GPS	Global Position System
GIS	Global Information System
ERP	Enterprise Resource Planning
T.Q.M	Total Quality Management
VSM	Value Stream Mapping
PDCA	Plan-Do-Check-Act
DMAIC	Define-Measure-Analyse-Improve-Control
SLZ	Smart Logistics Zones
MES	Manufacturing Execution System
IS	Information System
ICT	Information Communication Technology
IoT	Internet of Things
DES	Discrete Event Simulation
RL	Reverse Logistics
WMS	Warehouse Management System

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1 Chapter 1: Introduction

1.1 Introduction

Resources for production occur in remote places far away from where most people live. The natural resources need to be converted, transported, stored and delivered in adequate quantities to where demand is. An integrated, effective supply chain and logistics system is achieved by a well planned and coordinated effort. The food we buy at the shops, the deliveries from online purchases and the supply of medicines to remote areas is made possible by a well thought and co-ordinated logistics process. The importance of logistics has increased and so is the overall contribution to the economy. The logistics industry has presented considerable progress during recent years locally and globally. Activities of logistics are considered important in the manufacturing and trade industries. Logistics in the 21st century is considered amongst the most important industries along with technology and microbiology (Sezer & Abasiz, 2017).

1.2 Background

A high level of competitiveness amongst rival organizations and the increased innovation rate results in a market that is ready to take on new challenges. To increase the chances of success and survival organizations must answer challenges that are presented by logistics (Neeraja, et al., 2014). The chances of survival are slim if the product or service cannot reach the customer at the right place and at the right time. Organizations have to fullfil the needs of customers by responding in a strategic way and globalization has changed how companies make decisions. Because logistics has been integrated into activities that deliver services to customers, it is important that companies pay attention to this area of the business. The demands of competition ensure that customers receive products or services cheaper, better and faster (Pienaar & Vogt, 2016). This research seeks to proposition methods such as Smart Logistics Zones to facilitate the optimization in the logistics environment.

1.3 Problem Statement

Economic changes can spark the business enviroment to be dynamic. Organizations are seeking to attain high levels of productivity, to be cost leaders and leaders in the market. Companies can be the best in class and increase competitiveness by deriving the value in the links of the supply value chain and offer good customer services (Du Toit & Vlok, 2014). The

purpose of logistics is to be efficient and effective across the value chain, and to ensure the value chain is prosperous for all participants in the supply value chain. The definition of logistics is to ensure that information and goods are made available at the acceptable price to the customer, delivered to the right place, available in the right condition and quantities (Sreenivas & Srinivas, 2015). This research seeks to proposition methods such as SLZ to facilitate the optimization in the logistics environment.

1.4 Research Questions

The research focuses on the following:

a. What is the role of logistics in a global logistics organization?
b. What is the impact of implementing continuous improvement and productivity methodologies have on logistics?
c. Can a simulation tool be adopted to achieve logistics optimisation?

1.5 Objectives of the research

The research objective is the following:

a. Determine the role of logistics in an organization.
b. To determine the relationship between applying continuous improvement and adoption of technology in enhacing a competitive advantage in logistics.
c. Can a simulation tool be adopted to achieve logistics optimisation?

1.6 Research report layout

The report layout comprises three chapters below:

a. Chapter 1 - Discusses the introduction, problem statement, and objectives of the study.
b. Chapter 2 - Outlines the literature review in logistics and supply chain management, information technology in logistics, improvement methodologies in logistics and employee training and development.
c. Chapter 3 - Discusses the research methodology used to solve the problem.
d. Chapter 4 - Discusses the research findings and analysis.

e. Chapter 5 – Conclusion and recommendations

1.7 Conclusion

This chapter provides a high level of research embarked on. The chapter gives the background of the study, problem statement, research objectives, aims, and objectives of the study. The next chapter will present the literature review of the study/project.

2 Chapter 2 – Literature Review

This chapter discusses the review of the literature in logistics in the international platforms. The literature is extracted from journals, conference papers, and books. The below topics under logistics is covered:

a. Logistics and supply chain management.
b. Information Technology in logistics.
c. Improvement Methodologies in logistics.
d. Employee training and development.

2.1 Logistics and Supply chain management

Logistics is about ensuring the movement of goods, commodities, information, and energy in right quantities, at the right time and the right place. Logistics is also an integrative and support function with the goal of meeting the customer's requirements (Havenga, 2018). Over the last two decades, the evolution within the supply chain industry has ensured that companies in the value chain deliver value to the customer at the least cost to the supply chain as a whole. This is achieved by companies working together towards a common goal.

The logistics industry is an important sector as it facilitates increased trade between global countries. Goods reach the customer faster and at a lower cost. Logistics plays an important role in the growth and economic development of a country because it moves goods closer and commodities to where they are needed and consumed. The growth in the logistics industry has resulted in the increased competition among countries and it that makes it an essential part of the growth and development of the country. The advent of new innovative technologies has created new capabilities for logistics and also helps companies to achieve profitability (Malhotra & Mishra, 2019).

In the 21st century a recognition that competition is amongst supply chains and not between companies. This is because organizational success depends on the performance of the supply chain hence the improvement in the supply chain leads to an overall improvement in the company. The desire to improve the performance of the supply chain has seen many organizations across the globe implement supply chain management practices. Core to these practices is co-operation, training, and support in the development of services or products. (Hove-Sibanda & Pooe, 2018). Supply chain performance can be improved by enhancing collaboration between companies and the competence of supply chains is a result of a better

performing supply chain. Companies need to protect their core competencies so that they can derive all the benefits from them.

The logistics industry has grown globally and has become an important economic activity. Foreign trade export plays an important role in increasing a country's economic growth. The activities of logistics have increased the economic and productivity growth of a country. A country's competitiveness is determined by how efficient its logistics network is and this results in increased opportunities for employment (Erkan, 2014).

Modern organizations use competitive advantage as a business strategy and focus on delivering value to customers. This is done by providing services and products that are more valuable when compared to the products of competitors. For a company to achieve competitive advantage it should manage and integrate all activities from supplier to the customer (Sukati, et al., 2012).

The growth of logistics is closely related to the history and growth of markets in all industrialized nations. As a tool and as a science, logistics began from the early 1950s and enabled the growth of economies across the globe. Logistics helps organizations to optimize the supply chains and this is achieved by using management methods to increase competitiveness. Key to logistics is the transport network that links all the activities (Sakhapov, et al., 2018).

(Dima, et al., 2014) defines competitiveness as providing products in an efficient way than competitors. The goals of sustainable development are not only to take the needs of the organization but also the needs of companies that form part of the value chain.

Competition has moved into the supply chain from the single organization. Companies are beginning to realize that it’s inadequate to improve internal efficiencies but entire supply chain should be competitive. Supply chain quality management is an approach to improve the performance of the entire supply chain for the satisfaction of supply chain partners and final customer. This will enable the organization to be in a better position in market and differentiate the organization from competitors (Chaghooshi, et al., 2015).

Transportation is the most important logistics activity and is the most-costly logistics subsystem. The transportation of freight plays a key role in today’s economy and that is why the transportation process must be integrated into one coherent whole. Production and consumption that are thousand kilometers apart must be connected in order the ensure the

sufficient supply of goods and services is maintained. According to (Radovic, et al., 2018) transportation costs account for about 40% of the total cost and therefore it is important to work day-to-day to reduce these costs.

Reverse Logistics

Reverse Logistics (RL) enables resource circulation and sustainable production. RL is defined as the process of planning, implementing and controlling backward flows of finished goods, from a use point to a point of disposal or point of recovery. RL has gained attention because of global competition, sustainable development and legislation. RL is very different from forward logistics. RL is concerned about the recovery of goods from the customer to the disposal point (Sangwan, 2017).

Government legislation forces producers of goods to take care of end of life products and this has given attention to RL. The process starts from the end users and attempts to remanufacture, repairing, recycle, reuse and dispose are undertaken. The process of return flow has become important in the present business environment. This is because of financial, environmental aspects and better customer satisfaction many companies prioritize the performance of RL. The increased returned flows volumes varying from commercial returns, marketing returns and end of life has reinforced effective management of reverse logistics (Govindan & Soleimani, 2015).

Reverse logistics provides companies with strategic and revenue benefits. RL encourages the alternative use of resources that are cheaper and friendly to the environment by increase the life cycle of the product. Customers are willing to pay more for products that are environmentally friendly. Many manufactures are inspired by practices of reverse logistics by designing products that can be regenerated and dismantled for sustainable development. Cost saving and increasing profits is the main purpose of reverse logistics. Natural resources, energy and effort are saved by using alternative materials to replace original parts. RL provides an opportunity to recover the value of the returned product through repair, reuse and recovery process (Grabara, et al., 2014).

2.2 Information Technology in Logistics

Information Technology (IT) allows all the participants in the value chain to be connected in real time. IT is key to the support of companies in order to create a competitive advantage. This is done by decentralizing daily operation activities and centralizing strategic planning. IT helps in ensuring the synchronization of activities and having continuous information without interruption. This makes it possible for all the linkages in the value chain to coordinate and integrate processes. Because of live updates on the statuses on inventories, a downstream customer can be informed about the processes of upstream activities. Adoption of new technologies like Radio Frequency Identification (RFID) and Augmented Reality (AR) have contributed to the supply chain competitive advantage. An organization that executes a certain activity way better than their competition becomes a source of competitive advantage. An organization that performs these activities efficiently and effectively, leading to adding value to customers achieve a competitive advantage over its competition. (Miraldes, et al., 2015)

It is important to understand the role IT plays in the logistics and supply chain network. In the age of paper-based communication and transaction, the flow of information in the logistics network was time-consuming and more often incomplete. Due to globalization and the growth of information technology in logistics and supply chain. IT has improved communication in logistics and supply by aiding in optimizing decisions of the logistics and supply chain network for achieving higher levels of service, reducing risk and lowering inventory costs. This has also helped in achieving organizational competitiveness. IT applications such as RFID, Electronic Data Interchange (EDI), Barcoding and Decision Support System (DSS) also helps organizations to achieve information sharing and integration within the supply chain network (Varma & Khan, 2014)

Sharing of information in the logistics and supply chain network allows everyone to work together with the goal of a coordinated and integrated chain for better performance. Information reduces risks and enhances the performance of the supply chain because it provides decision makers with the correct information of all executed transactions. This is where the role of information technology becomes important. All the software and hardware applications help in the integration of all the players in the value chain from suppliers to customers. With information technology, important information can be gathered and also react to the changes in the market thereby gaining a competitive advantage. Electronic records management is implemented to ensure accountability in the process flow and to reduce cybercrime during e-commerce. The applications for electronic records management are Enterprise Resource Planning (ERP), Electronic Data Interchange (EDI) (Reddy, et al., 2015).

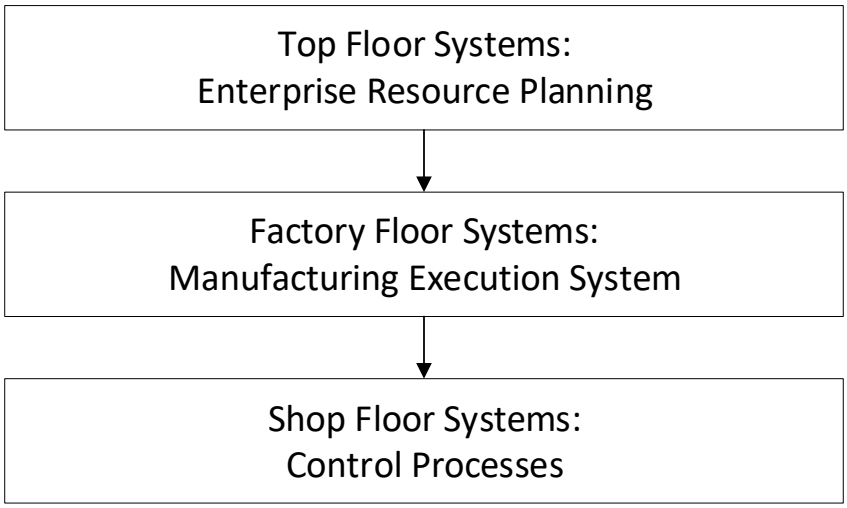
Without information technology in today's business world, it would be difficult to have effective communication. Information technology facilitates and enables organizations and suppliers to share real-time information frequently and openly. Information technology also fosters the integration of logistics activities by the high use of information technology applications such as EDI and Decision Support Systems (Ndonye, 2014)

Customer, Competition, Change, and Cost is compelling organizations to embrace the use of information technology. A new world for business is created by the 4 C's. Organizations have to adjust and respond to these parameters through the use of information technology. Organizations can reduce cost, expand their businesses and maximize revenues by streamlining supply chains. Globalization has enabled the use of information technology to manage logistics and supply chain activities across the globe. Emerging technologies that will affect the logistics chain are RFID – radio frequency Identification. These are tags that can where the product is, what the product is and when it expires (Waghmare & Mehta, 2014)

(Gurung, 2015) states that Information technology as a productivity tool can be used to decrease costs and to increase the capability of the organization. Companies that properly implements information technology applications can also be used as a differentiator against their competitors.

Technology is a means to enhance performance and the competitiveness of businesses. Technology plays an important role in the success of the logistics and supply chain system by increasing its efficiency and effectiveness. Technologies used in logistics are divided into these parts: Planning, Execution and Control systems (Olah, et al., 2018)

Figure 1: Automation systems to plant system overview



2.2.1 Communication and Identification Technologies

Strategic opportunities are created by new technologies to build a competitive advantage in logistics and supply chains for global organizations. The degree of success depends on the selection of the right technology for the application, management policies, culture and availability of the correct infrastructure. Communication and identification technologies has improved the speed of processing, analysis and transmission in logistics. Technology plays an important role in logistics and is a means to enhance performance and competitiveness. Bar- Coding, Radio Frequency Identification (RFID), Electronic Data Interchange (EDI), and Global Positioning System (GPS) are various forms of communication and identification technologies that will be discussed.

Bar Coding

Information technology includes all activities that are related to computer-based processing and it is not made up of a single technology. Information technology is a combination of multiple technologies that aim to optimize and enhance the user's experience. Information technology includes telecommunication devices, satellites, and computers. Organizations use information technology to retrieve, organize, acquire and store information. Automation plays an important role in our daily lives and that is why libraries have adopted the use of bar-code technology. (Fatima & Ansari, 2017) defines bar codes as identified and self-contained messages that are encoded with a particular printed pattern. The bars have specific importance of a class number. Bar codes consist of thick black lines and white spaces which signifies a series of character readable by a computer. Bar codes are simple, machine-readable and graphical in nature to record data. The objectives of using barcoding are to improve efficiency, easy processing of stock verification and to reduce costs.

Bar code technology has been used in the medical field to improve the administration of medication. This information contained in the bar code is the patients' name, time, drug and dosage of the patient. When a patient is admitted to a hospital the patient is given a barcode wristband and is used to confirm that the correct medicine is administered to the patient. The patient's medication also contains a bar code which is linked to the patient's wristband barcode. The application of this technology reduces the risk of adverse drug events. This technology also reduces administration errors and implementation of the technology is cost-effective. Implementation of this system has improved patient care. There are two types of bar codes namely the linear bar code and 2D bar code. Linear bar code store numerical data and

has long black lines. 2D bar code store any data and normally made by having a matrix symbol shaped in black and white cells (Truitt, et al., 2016)

Radio Frequency Identification (RFID)

RFID uses radio waves to transmit information about the identity of an object that has a unique serial number and it does not require manual intervention. RFID is similar to barcode technology, but it does not require the tag to be visible of the item. RFID requires a reader and a tag attached to the product to enable easy tracking of the product. RFID enables items to be easily identified and provides benefits. RFID technologies can be classified into these categories: semi-passive RFID, active RFID, and passive RFID. The technology has been in usage for more than 50 year's but it is only now that the RFID has gained momentum because of its increased capabilities (Sun, 2012)

To be successful in the global economy, it is essential for an organization to build a logistics network that is rich in information, highly flexible and less in cost. The use of modern technology should be the first step in setting up an efficient and effective supply chain so that the expenses in the supply chain are reduced. RFID should be seen as a tool that increases competitive advantage and also as a strategic tool. RFID can be used in many ways to reduce costs and also to streamlining processes. For retailers, RFID can be used to ensure that sufficient amounts of a product are available and in what quantities. It can also be used where a customer can view a product and also see complementary items to the product (Zhu & Li, 2018).

RFID is a promising wireless technology that collects identity information from the tags to the readers. It is also suitable for the surveillance of mobile objects and also has characteristics to identify items from a long distance and can handle large volumes of information. RFID technology can be used on moving objects as long as their speed and path can be predicted but for this to work the system would require multiple readers. The region into which a reader is interrogating on is limited, so that is why reader planning is important to object-based surveillance (Araujo, et al., 2015)

Electronic Data Interchange (EDI)

For many years industry and commerce relied on the movement of written documents. The information in these documents contained credit notes, invoices and other related information. The problem with these documents was that they were not in the same standard between

receiver and sender. This created a problem because the receiver would have to spend additional costs to convert the information into the required standard. Time was also a factor as the lag between sending the document and receiving it for processing. Sometimes the document would be lost accidentally. Today most organizations have adopted technology to improve the way of doing business and also to increase their competitive advantage. As technology evolved new systems were created into which organizations can communicate efficiently with capabilities and links to communicate. One such application which can be used to share common information instantly is called the Electronic Data Interchange or commonly known as EDI. EDI is used to transfer documents from one organization to another organization. Information transferred can be invoices and data related to inventories. The use of EDI technology promotes paperless transactions (Njoni, et al., 2016)

Electronic Data Interchange is an electronic exchange of business information between departments within a business or trading partners. EDI facilitates the processing and exchanging or large volumes of data. EDI improves the logistics process because of its fast processing of information. It is beneficial in the logistics process because information related to shipment can be received before the arrival of the shipment also it helps in the verification upon the arrival of the shipment (Bahija, et al., 2016)

EDI is befitted as a tool for execution and adapting business processes near an integrated logistics. Implementation of EDI has several benefits which are to process transactions faster, improving trade relationships of parties within a supply chain, reducing of cost because the system is paperless and conversion of information is not required because the information is received in the correct format. The difference between EDI and electronic messaging is that EDI is created using one software and translated by another software while e-mail is composed and interpreted manually (Kiggira, et al., 2015)

Electronic Data Interchange has become a tool for rendering and adapting processes towards integrated logistics. Electronic Data Interchange is a technique used for communicating between organizations to transfer important information. EDI can be applied in many sectors and is a way to improve business processes. EDI improves productivity, reliability, and availability of information (Reddy, et al., 2015)

Automated Guided Vehicles (AGV's)

Automated Guided vehicles over the past 50 years have developed into efficient and reliable technological equipment. Automated Guided Vehicles are used within logistics systems and

many other industries. The digital factory is a model of a real production which shows all the processes in a virtual image. This is done for the purposes of planning, optimizing and simulating the manufacture of complex systems. The author states when an AGV's system is modeled the focus should not only be on the movement of the vehicle but also the material handling process to which the system will be integrated on (Neradilova & Fedorko, 2017).

Automated Guided Vehicles have been important in today's logistics world. Advances in technology and the increased competition has put more on organizations to meet and exceed customers' expectations. This has made organizations to improve their systems to be more efficient. Automated Guided vehicles have been in existence since the 1950s. AGV's are a smart and most efficient option of transporting goods in industrial settings. This application is enabled by the use of RFID technology for guidance and motion control (Mehami, et al., 2018).

Hospitals have increased their demand for mobile robots and this is due to changes in hospital operations. AGV's in healthcare facilities are designed for handling and transportation of food, waste, pharmacy medicines and also laboratories samples. The efficiencies gained by using these means that human resources can be transferred to other areas where they are most needed (Pedan, et al., 2017).

Artificial Intelligence, big data and cloud computing will be integrated into existing services and industry. In the logistics and manufacturing industry, everything will be connected to a network and will be intellectualized. The integration of AGV's, deep learning and big data will make factories smarter (Cheong & Lee, 2018).

Automated Guided Vehicles are driverless vehicles that are programmed to travel a predefined path and are used as material handling systems as they improve efficiency and decrease human labor. Because of this, the availability and reliability of AVG systems is important to ensure that the system is fully operational. The maintenance of the AVG system should be a priority of all organizations that adopt this system (Yan, et al., 2018).

Geographical Positioning System (GPS)

The application of technology in the logistics and transportation industry has led many organizations to increase their competitive advantage. GPS technologies help in solving problems by providing real-time data and information. Implementing GPS technology also helps the logistics service providers to comply with the industry practices such as the just in time (Musa, et al., 2017)

Global Positioning System is not only used for military purposes but also for civilian applications. A perfect example of this is used in healthcare applications. The patient tracking location system is a system used to help caretakers and family members to locate the patient in emergency situations (Yigit, et al., 2017).

(Zein, et al., 2018) stated accidents are caused by human errors. These accidents will continue to increase due to the increasing density of traffic. Engineers have been searching for ways to minimize human input in driving vehicles. The need to develop driverless vehicles arose so as to reduce accidents and to spare human lives. The use of GPS technology will be very important in these vehicles. The driver will only input their destination and the vehicle will use the internet with GPS proceed to the destination.

Organizations track their vehicles to decrease costs and to increase visibility. By using the GPS system, objects can be tracked and shared through the internet. These solutions help in the monitoring of objects in real time. GPS can be integrated with Global Information System (GIS) technology to improve services and to reduces costs. The use of GPS technology also helps in the optimization of routes and it improves scheduling for the logistics industry (Mihajlow & Demirev, 2018).

2.2.2 Manufacturing Execution System (MES)

Usage of computers in automation for capturing real time data started in the 1960's. In the knowledge-based economy data plays an important role. Before Manufacturing Execution Systems came, data was available in raw format from the control system and has been a tedious job to capture data accurately. Manufacturing Execution System was introduced as a tool to capture real time data, quality control, report generation and analyzing for better decision making in the manufacturing industry. Manufacturing is a computerized system that is operated to control manufacturing systems within the enterprise. MES is a flexible tool and easily customizable system with powerful functions. The benefits of implementing MES system are the reduction of waste and scraps, faster setup times for equipment and increased line efficiency (Banerjee, et al., 2013).

Manufactures are pressured to meet and exceed high standards of industrial performances and to deal with constrains relating to environmental regulations for sustainable production. The problem is caused by the lack of vertical integration of different sources of data within the organization. Manufacturing Execution System is an important analysis tool in the

manufacturing environment. The data analysis allows the flow and integration of data vertically to the Enterprise Resource Planning. The equipment and entities of the organization will function in an efficient way with no risks to achieve a common objective (Mitrea & Tamas, 2018)

Benefits of implementing a MES

Companies have no choice but to adapt to rapid changing market requirements. The digital revolution is shaping factories around the world. Internet of Things (IoT), Virtual Reality (VR), 3D printing and robots are driving cost reductions and improvements in productivity of production processes. Companies in the race to be a leader in the digital world often ignore basic building blocks needed to setup a smart factory. MES is one the important blocks often overlooked by system designers. MES functions as a nerve center in a production operation, where all transactions relating to machine status, dashboards and traceability are logged in the system. MES benefits the production operations by communication work statuses and coordinating the all the support functions. MES also functions as a dashboard where bottlenecks or potential problems can be identified before causing irreparable harm to the operation (D'Antonio, et al., 2017).

Fast changes in the market require manufacturing systems to be flexible and to allow adjustments product mix in order to enhance growth. Production systems used for controlling the enterprise are not integrated and this prevents the organization to exploit the opportunities in the market. Manufacturing Execution Systems (MES) are used to overcome these disadvantages. Manufacturing Execution Systems are systems used to communicate between components and also communicate real time constrains within enterprises. An organization that uses MES benefits by having reduced cycle times, lead time and uses less paper work. MES helps in improving product quality and customer services (Jiang, et al., 2015)

MES as a system for integration and communication

Leading organizations in different sectors that aim to maintain and improve competitive advantage need to improve process efficiency and optimization. Organizations may undertake to implement lean manufacturing practices, deployment of automation and Information Communication Technology Tools. Adopting the above will lead to improved control and process planning and enhanced performance in steps of the manufacturing process. In modern times the focus is on the integration and the communication between tools of information within the enterprise. Manufacturing Execution Systems play an important role in

this integration. MES is in charge of data collection, analysis and dispatching the resulting information (Antonio, et al., 2017).

MES is an application that links top level Enterprise Resource Planning with Information Systems (IS) at the lower level namely the automation system. MES provides the base for optimizing the entire production process in real time. Implementing MES helps organization to have access to real time data that will help the production department to improve product quality. MES can be used as a strategy for increasing competitiveness for the organization. The implementation of ERP, MES and other automation systems within a production company elevates the organization and increases competitiveness in the market (Govindaraju & Putra, 2016).

The great challenges in the manufacturing industry is the integration of manufacturing and process information with other departments in the company. Manufacturing environments are supported with applications that manages activities in the organization but with no horizontal integration. Adopting technology like MES can fulfill the gap in the manufacturing environment. MES are systems that links and integrates the manufacturing floor and the corporate management system. MES systems allow the optimization of manufacturing activities to be possible and supplies important information to the organization on productivity of the supply chain (Blanco, et al., 2014).

Competition in the global market has caused changes and benefits for the customers. These benefits include cheaper products with high customization and products are supplied quickly. Organizations are adopting innovative technologies to satisfy customers with cheaper products with high customization. Global companies are using their ability to respond quickly to customers as a competitive feature. Automation of the plant floor has increased because companies want to increase efficiency and differentiation. Implementation of ERP and control systems has created a new problem for the organizations. The problem is caused by the lack of communication and integration between the planning systems and the control systems. A solution to solve this problem in the production area is to adopt a MES that links the planning and control system which will lead to improving the manufacturing process. MES ensures that decision making is based on reliable and relevant information. MES also integrates the planning and mapping of the entire production stages in real time (Neves das, et al., 2015). MES also ensures that the companies' strategic areas are imbedded with ICT solutions to improve its efficiency and to reach organizational goals.

MES and the internet

Industry 4.0 is the new industrial revolution based on the evolution of Information Communication Technology (ICT) together with Internet of Things (IoT). This type of new industry is based on the Smart factory model. This production approach allows customers to be satisfied and also real time information of production status is available. Internet of things (IoT) is a term used to describe interconnectivity between appliances and devices through the internet. The application of this concept enables organizations to increase profits. One of the important possibilities is to track the execution of manufacturing by using RFID system and thereby creating a system called RFID-enabled Manufacturing Execution System. RFID technology enables real time data collection and to be readily available when needed. This kind of live tracking of production connected with Enterprise Resource planning (ERP) system leads to improved planning and making companies more profitable (Mladineo, et al., 2017).

Globalization causes an increase in the production plants that manufacture multiple ranges of products. E-commerce and the internet lead to an increased demand for products that can be customized using hybrid manufacturing techniques as opposed to normal manufacturing techniques. Products are critiqued by customers and the high competition leads to production facilities needing to operate at high standards. This can be done by optimizing production rates, reducing machine downtime, improving delivery times and managing schedules of machines and workers. The above functions form the basis of Manufacturing Execution Systems. MES also offer tools for optimization as a function (Menezes, et al., 2018).

The lack of integration between enterprise control systems and information systems leads to poor communication and delayed responses for the organization. In MES parties that are communicating must have the same understanding of the meaning of the information exchange. The information that is exchanged should be valid and highly accurate. The information collected in the network is used to improve the performance of the organization and customer satisfaction. Data is shared in real time and it is achieved with the use of cloud computing. Cloud computing enables fast real-time communication, and this enables organizations to make better decisions (Gocheva, et al., 2013).

2.2.3 Enterprise Resource Planning (ERP)

A supply chain is becoming competitive and that makes organizations to seek differential in service or products. When information technology is used well it creates a competitive advantage for the organization. Information technology systems in logistics activities create

linkages and connections for an integrated logistics process that combines software and hardware. The main goal is to track, measure and manage operations along the entire supply chain. Enterprise resource planning or ERP is used as software to integrate the organizations' software and to change the way people work. ERP systems optimize the supply chain system and create a competitive advantage by ensuring that customer requirements are responded to quickly, improvement of turnover in logistics and reduction in inventory costs (Leu, 2014).

The competitive environment in today's business world requires greater interaction between the business and the customer. This entails that the business should be linked closely to the supplier as well as the customer so that the goods produced can be delivered faster. For this to be achieved, organizations need to have effective planning and control systems in place. Companies can use information technology to achieve these efficiencies and Enterprise Resource Planning is the best tool for this. ERP is a software package that can integrate all processes of a business. ERP system was used widely in the manufacturing environments but due to the efficiency, they deliver they have been adopted in all business spheres. ERP system helps multiple systems to work together and ensures an effective flow of information through the organization (Yildirim & Kusakci, 2018).

Increased investment will lead to high performance and greater market share. This has also led to reduced redundancy and improved data which enables better decision making. Recently there has been a rise in the implementation and adoption of IT systems to automate processes and improve efficiency by organizations. ERP provides this solution and more. ERP is a software solution that enables all transactions of an organization to be integrated. ERP helps in the managing of the logistics function by linking all the information relating to orders, deliveries and products from suppliers to customers (Yaroson, et al., 2013).

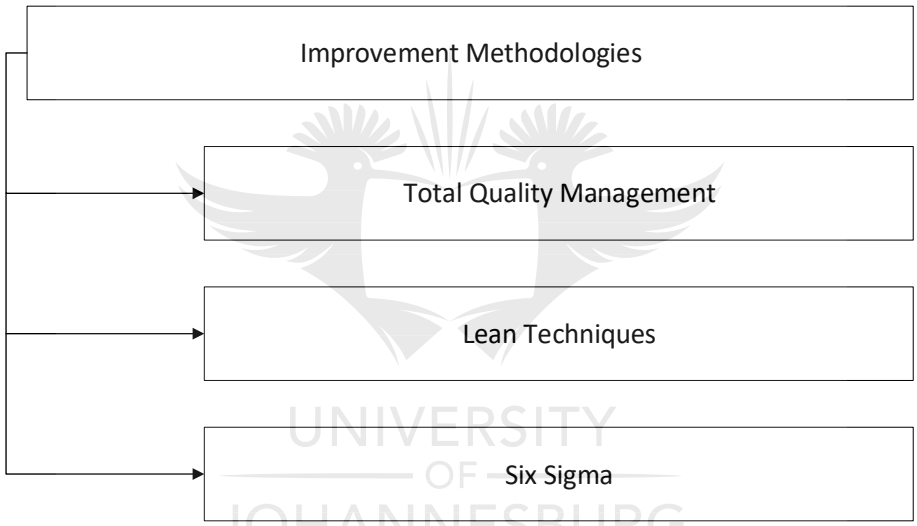
ERP systems are the backbone of the enterprise mainly due to the control applied on the organizational resources and transactions. ERP systems are solutions that integrate systems by replacing incompatible costly structures of the enterprise. ERP systems are used to increase productivity and to achieve better flow of information across departments (Osnes, et al., 2018). The development in manufacturing and operations management has led to many choices for organizations. Whether is it e-Business, customer relations or information management, continuous improvement is expected and a necessity. ERP and lean manufacturing are important tools in the manufacturing field. Lean makes processes effective and efficient while ERP is an integrated view of the business processes. The benefits of ERP

have increased productivity, access to reliable information and improved responsiveness (Jituri, et al., 2018).

2.3 Improvement Methodologies in Logistics

In the present day, the demanding business environment forces organizations to improve or close down. Reducing costs is often high on the agenda of top management. To reduce costs organizations, need to improve processes and eliminate waste. Continuous improvement is a name given to a group of activities that aim to reduce waste and improve processes. These methodologies are Six Sigma, Lean and Total Quality management.

Figure 2 Improvement Methodologies



2.3.1 Total Quality Management (TQM)

Total Quality Management is a methodology that offers value to customers by putting their quality needs at the center. This is driven by the pursuit of making small changes in the operation and ensuring that all prosses in the organization have customers. TQM requires full participation from everyone in the organization and pursues productivity in all processes. The reasons for organizations to implement TQM is to reduce costs, losses and to achieve customers satisfaction. The approaches adopted by TQM are inspection, quality control and assurance (Kozlov, et al., 2018).

(Haddas, et al., 2014) states that implementing continuous improvement tools will reduce failures and increase successes. Continuous improvement aims to minimize variations,

reduce waste and to increase the productivity of all processes. TQM is a branch of continuous improvement methodologies that help organizations to achieve excellence and enhances creativity within the workforce.

Organizations are operating under a complex and dynamic environment. This forces organizations to be creative and to implement good practices to survive and to attain competitive advantage in the marketplace. Implementing continuous improvement tools allows organizations to be better, efficient and effective. Continuous improvement is a closed loop that consists of understanding the requirements of customers, meeting those requirements and to continuously improve to exceed those requirements (Sanchez-Ruiz, et al., 2019).

The health of organizations depends on their level of commitment to improve and to embrace change. To be competitive, organizations need to be quicker, better and cheaper. Continuous improvement is a philosophy that is effective when there is a commitment from top management. Continuous improvement is an ongoing process of improving a process and it never ends (Kovach, et al., 2011).

Customers demand cheaper and products of high quality. This places pressure on companies to improve efficiencies and to reduce production costs. (Roriz, et al., 2017) states lean manufacturing with Total Quality Management has proved to be enough in helping companies improve processes. Lean techniques aim to improve efficiency and reduce waste. Implementation of lean principles should be supported by committed leadership and a supportive learning environment.

2.3.2 Lean Techniques

Lean management is one of the top tools that eliminates waste in any process. Lean is also a means of creating more value for the customer. The techniques of lean can be applied in any environment. The background of lean is based in the history of Japanese manufacturing techniques which have applied in many industries around the world. Value Stream Mapping, Process Mapping and the Plan-Do-Check-Act (PDCA) cycle are some of the Lean techniques that will be discussed in this section.

Value Stream Mapping (VSM)

(Venkataraman, et al., 2014) states that lean manufacturing is a continuous improvement technique that focusses on improving productivity by eliminating waste. Lean Manufacturing aims to enhance the production process and believes that customers only pay for the value derived from products and not the additional rework costs. Value Stream Mapping is a lean manufacturing technique that aims to improve the process flow required to produce a product. A value stream map is a representation of a process visually so that areas of waste can be visually identified.

Manufacturing companies are faced with challenges of reducing lead time and improving the quality of products. An important task facing companies is to select an appropriate solution that will integrate all inspection processes with manufacturing to ensure that the correct product to deliver to customers. The Quality Value Stream Mapping is an effective tool that is used to analyze and improve quality related issues within a value chain (Haefner, et al., 2014). VSM is used for the analysis and improvement of mass production processes through the reduction of waste. VSM can be used to improve assembly, manufacturing, and product development processes. Great value can be derived from a VSM when combined with computer simulation. Computer Simulation can be used to assess the effectiveness of the VSM results (Antonelli & Stadnicka, 2018).

Plan-Do-Check-Act cycle (PDCA)

(Patel & Deshpande, 2017) the PDCA cycle is iterative four-step applied to gain learning and knowledge for the continuous improvement of a process. PDCA is also known as the Deming Cycle used for the quality and productivity improvement of business operations. PDCA has been found to be effective than most continuous improvement tools. PDCA can be applied in any industry or process with the aim of improving.

Companies use different approaches and techniques for implementing a quality improvement program. The most effective amongst them is the Plan-Do-Check-Act cycle which is more than a technique but can be integrated and embedded into the company culture. The PDCA cycle is mostly used as the deployment and development of quality policies (Sokovic, et al., 2010). Customers demand products that have value add. The value-add process is considered continuous and never-ending. Value add is not a function of the manufacturing process but everyone in the organization because all the functions add value to a product or service

whether tangible or non-tangible. The value-add process can be analyzed in terms of the PDCA cycle because of its continuous nature (Gidey, et al., 2014).

2.3.3 Six - Sigma

Changes in the market require supply chains of organizations to be flexible and adaptable. The automotive industry is a highly competitive environment and requires companies to constantly seek operational excellence. For organizations to thrive, a commitment to deliver products or services of high quality with zero defects should be made. Six Sigma has been widely used in many types of industries. Six Sigma originates in the 80s from Motorola and was initially used to improve a process. Today it has been adopted by many industries such as purchasing and marketing to ensure customer satisfaction. Six Sigma is the application of tools and techniques to increase returns on investment (Costa, et al., 2017).

The current economic situation forces organizations to seek profitable solutions to gain a competitive advantage. For this reason, many companies are searching for methodologies to improve their products and to reduce costs. The integration of Lean and Six Sigma helps organizations to achieve this. Lean is focused on the reduction of waste and Six Sigma on ensuring that process variation is reduced by using statistical techniques (Tenera & Pinto, 2014).

Six Sigma is considered the best way of reducing variations and improving product quality. The desire for organizations to achieve excellence requires commitment from management and to train, motivate and involve all members of staff. (Pugna, et al., 2016) Six Sigma helps organizations to increase profitability and increase customer satisfaction by using statistical tools. Six Sigma has two approaches DMAIC used on existing processes and DMADV applicable to new products.

Over the last 20 years, there has been a determination from an organization to improve product quality and to reduce the number of errors. Customers are at the center of the economy and that is why organizations have to gain and keep them. Many methods out there are used to help companies to maintain good quality levels but not all of them achieve this continuously. Six Sigma is used as either a strategy or a philosophy. (Smetkowska & Mrugalska, 2018) when used as a strategy six sigma helps the company to develop and improve the company's position. When used as a philosophy six sigma changes and transforms the company.

Customers are important to any business and companies should always strive to ensure that their expectations are met and exceeded by delivering high quality and reducing costs. This will lead to organizations gaining more customers and increasing market share. Six Sigma is a methodology that helps companies to achieve the best results. (Srinivasan, et al., 2014) defines six-sigma as a disciplined methodology for reducing variation, improve quality and reducing costs. The unique success of Six Sigma is the step by step of the DMAIC methodology.

Pressure is placed on organization to improve quality and customer satisfaction. Customers are key drivers in the economy and that is why organizations have to keep them happy. Many concepts and methods exist that helps organizations to achieve and maintain high level of quality. Six Sigma is a client-oriented, organized and systematic approach tool that an organization can adopt to improve the quality and performance of processes. Six Sigma can be used as a strategy to improve the position of the company and can also be used as a philosophy for the transformation of the enterprise (Mrugalska & Smetkowska, 2018).

2.4 Simulation

Simulation provides a cost effective and decision-making tool for managers. Simulation techniques are used to deal with uncertainty. Simulation is a method used to tackling problems by constructing a model of the related system. The extensive use of simulation tools confirms its practical utility and relevance. Many firms use simulation in decision making processes related to their production networks and global logistics. A popular simulation technique for modelling logistics is Discrete Event Simulation (DES) (Liotta, 2012)

Simulation technology holds promise for improving quality, cost reduction and reducing the time to market. This technology remains underutilized by industry. Simulation focuses on modelling the behavior of manufacturing systems and processes. Some examples of applications of simulation include modelling and verification of continuous and discrete processes. Models of simulations are built to support decision making in management of materials and investment of new technology (McLean & Leong, 2013). These decisions have a long-term impact on the failure or success of an organization. Simulation offers the capability to conduct experiments to evaluate and predict the results of logistics decisions.

Modelling and simulation tools are used to analyze complex factors within a manufacturing environment. Simulation models that represent processes can be simulated because of fewer

restrictive assumptions. Simulating a warehouse process does disrupt ongoing activities in the warehouse and this helps with problem identification (Nyemba & Mbohwa, 2017).

Simulation is the imitation of a process over time and involves the generation of an artificial history to draw inferences regarding the operation characteristics of the real system. A model is developed to study the systems behavior that evolves over a period of time. Simulation can be used when the knowledge gained during the designing of the model could be of great value toward suggesting improvement in the system. Simulation should not be used when costs exceed the savings (Banks & Carson, 2010)

2.5 Employee training and development

Training and development of workers play an important role in achieving business objectives. Employees are the most important resource of any organization and that is why they should be continuously trained and developed. Training and development is essential in the business world because it increases the effectiveness and competence of workers. (Kumar & Patro, 2018) says training is a involves improving the skill, knowledge, and attributes of workers. Development is a process that covers training and also activities which brings growth in personality and realization of potential capacities which will not only make them good workers but better men or women. Training improves the performance of workers and also reduces the gap between expected and actual performance.

Employee training and development is an important aspect of making the business achieve profits. Training is important to the organizational strategy for competitive advantage and staying in business. Training and development involve designing programs to improve skills to better perform in the workplace and leads to changes in behavior. (Hanaysha & Tahir, 2015) Training is also defined as a systematic process that aims to make employees more productive by enhancing their skill, knowledge, and behaviors.

Training and development are defined by the (Borate, et al., 2014) as the acquisition of attitudes, rules, skills, and concepts which will result in improved performance of the employee. Employee training is essential as it would lead to better performance for the organization.

Training and development are an activity with the aim of improving the performance of employees. This is done to improve the organization performance to remain competitive in the market place. Training enables shorts term goals to be achieved and development is

responsible for the long-term view by preparing the employee for future roles within the organization (Meerut, 2014).

(Kesen, 2016) says not only is training and development used to prevent high turnover rates but also used to effect on work outcomes. Training is a process of sharing knowledge and skill to develop the capabilities of employees, so they can be productive. Training increases the quality of customer service and the company's financial performance.

In the article (Chaubey, et al., 2017) states the growth and performance of organizations rely on sustaining the performance of employees. This is achieved through training and development of employees. Training increases employee involvement and creates an employee-centered culture. The article states that trained employees perform better compared to untrained workers. Therefore, is it necessary for organizations to give their employees training to get the best results? Training also makes employees feel valued and important because employees are given opportunities to develop.

Employee training is not only essential for the growth of human resources but also ensures an allowable human resource in the organization. Employee training is one of the ways in which an organization can increase its competitiveness and training plays an important role in the development and survival of the organization (Zhang, et al., 2019).
(Hanaysha, 2016) states that productivity is important for organizational competitiveness and reaching desired targets. Efficient and effective utilization of human resources is also important and improving employee productivity is central in all organizations. This is because increased employee productivity impacts performance and competitive advantage.

Training and development lead to the maximum utilization of human resources. The skills obtained by employees leads to increased output inefficiency, morale, reduction in supervision and increased organizational flexibility (Genesh & Indradevi, 2015).

(Asfaw, et al., 2015) states formal education does not adequately teach job-specific skills for organizations. Also, few employees have the required skills and competencies to effectively work in their organizations. Thus, the need for training and development in most organizations. The training received by the employee will close the gap and empower the employee with the requisite knowledge and skills required to be effective with their daily tasks.

2.6 Conclusion

This chapter gives the theoretical framework for understanding the role of logistics, technology in logistics, improvement methodologies in logistics and the importance of employee training and development. The next section of the report gives the methodology used to conduct the research.

3 Chapter 3 – Research Methodology

3.1 Introduction

The previous chapter explored a comprehensive background context and support literature specific to this research. The literature review identified the role of logistics in the global organization. Considering the literature review, this chapter commences by reinstating the research questions and provides the research methodology approach to solve the research problem.

The research questions for the study are tabled out as follows:

- What is the role of logistics in a global logistics organization?
- What is the impact of implementing continuous improvement and productivity methodologies have on logistics?
- Can a simulation tool be adopted to achieve logistics optimisation?

3.2 Research Design

According to literature (Karakikes & Nathanail, 2017) states that simulation is a valuable tool to support decision making and to assess the impact of logistics solutions before implementation in the field. (Sanders, et al., 2016) describes lean manufacturing as a methodology to decrease costs and improve productivity in logistics organizations. Lean manufacturing provides a variety of tools which helps in the identification of waste and manufacturing a product with better quality (Modi & Thakkar, 2014). The researcher seeks to link the lean process with simulations in the logistics industry.

A case study is used to identify and explore warehouse operations in a global logistics company in South Africa. The warehouse operation process flow is sequential; therefore, Discrete Event Simulation (DES) is used. (Bjorbaek, et al., 2018) states that DES helps in making the right decisions and can be used in feasibility studies to optimize logistics systems with a view to improve performance. According to (Kampa, et al., 2017) DES is a widely used method for solving scheduling and efficiency problems. DES has the ability to perform experiments using a model of the actual scenario that helps in gaining knowledge that could lead to the improvement of the real system.

The study aims to test how operations can be optimized by creating Smart Logistics Zones (SLZ) in the warehouse. (Kirch, et al., 2017) describes SLZ as a multiple use of technical systems for localization, identification and monitoring of different object levels in production and logistics processes. SLZ are scalable and are equipped with ICT which form an ambient intelligence system to monitor logistics processes of goods, staff and resources. According to (Zhu & Li, 2018) RFID has been identified as best fitting technology for the object identification in SLZ.

Key to the study is to optimize cycle times and observe the impact on the output. The organization, selected as a case study, plans to create SLZ in the warehousing process and the purpose of the study is to explore the feasibility of installing this system. The performance indicators of the current state is to be compared with the future state to determine the most optimal way of operating the warehouse. According to (Edtmayr, et al., 2016) a VSM is a highly accepted technique for improving processes using lean techniques. (Ellingsen, 2017) describes a VSM as a tool used to increase a firm's efficiency and used to identify how information is transformed from raw material into the finished products that customers will pay for. (Azizi & Manoharan, 2015) states that a VSM is used to help in the identification of wasteful activities in production processes. The movement of products and resources used in the warehouse is represented by current state VSM. Data for the current state VSM is collected by observing the operations within the warehouse.

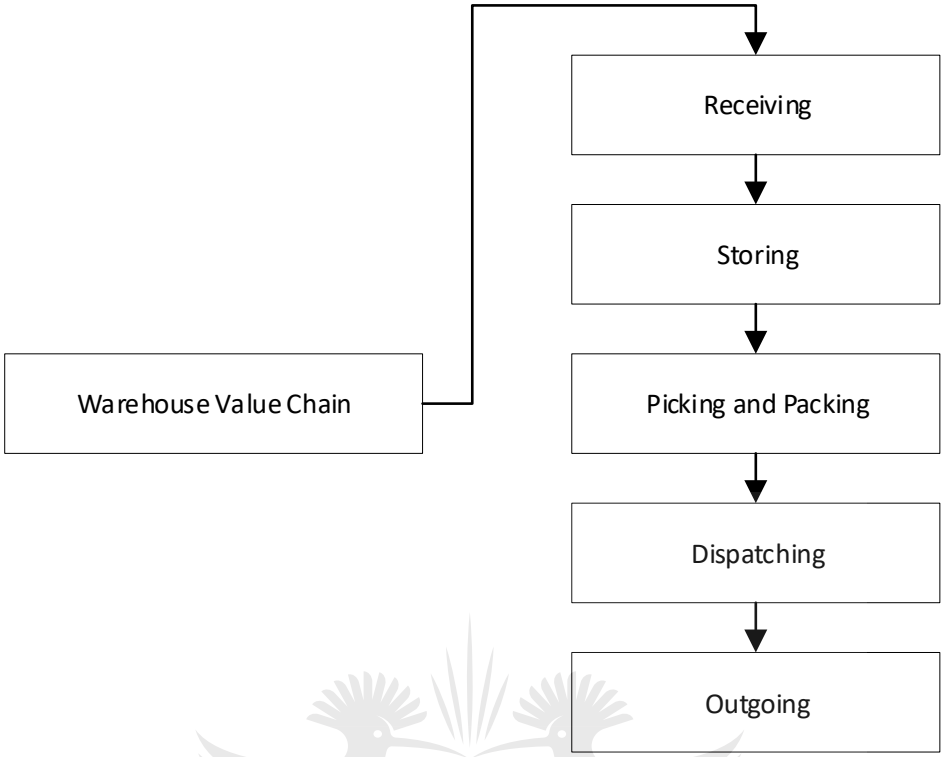
3.3 Data Collection

Documented records of incoming, inventory and outgoing volumes are collected from the Warehouse Management System (WMS) and data from the observations will be used to determine the time spent in the process and bottlenecks, capacity of each work center and utilization of the production resources. Sample data is used to develop the current state of the VSM. Consequently, the current state VSM and sample data is used to configure the simulation model of the warehouse value chain.

3.4 Current Process Flow

Figure 3 depicts the warehouse value chain and the scope of interest will be focused on receiving, storing, picking and packing, and dispatching.

Figure 3: Warehouse value chain



Incoming and receiving

Transport is unloaded and the load is received by operations staff. Goods are transferred into storage. Checking of the quality and quantity happens in this section. The packaging must be suitable for storage and in good condition.

Storing

Goods are moved into the allocated space for storage and to avoid errors clear marking of all spaces is done. The goods must be confirmed in the warehouse management system. The operator places goods into designated slots for storage and clear marking of all storage areas must be done to avoid errors.

Picking and packing

Once the order has been processed an instruction to pick from the warehouse management system is issued in the form of a pick note. The pick note contains information of the order and the location of the product. The picker picks all the products that are required and completes the process by moving the products to the assembly area.

Dispatching

Goods from warehouse sections are accumulated into suitable loads for transportation and this must be done efficiently to minimize transport costs.

3.5 Simulation Modelling

The researcher uses the sample data and the developed current VSM of the warehouse value chain to construct the simulation model which is developed using Anylogic 8.5.1 University Researcher Edition software. Anylogic simulation software is adopted for accomplishing this research because is supports discrete event simulation and there is a library of objects that help to create discrete event patterns frequently used in the discrete event modelling. As stated in the previous section the study aims to determine operations optimization via Smart Logistics Zones (SLZ). Figure 1 depicts the warehouse value chain. The process starts with the incoming and receiving of freight, followed by storage of freight. Orders are received then items are picked and packed and prepared for dispatching. The last process is dispatching of freight to destination.

3.6 Model Design stages

Four stages are followed in studying, developing and analyzing the current warehouse value chain.

Stage 1: Process Mapping

The value chain of the warehouse is developed and figure 1 illustrates all the steps followed in processing goods in the warehouse. The scope of interest in this study is focused on receiving, storing, picking and packing, and dispatching of goods in the warehouse.

Stage 2: Data Collection and construction of VSM

Historical data is collected on all processed volumes in the warehouse. A VSM was constructed using data collected from direct observation of operations in the warehouse.

Stage 3: Initial simulation model

Initial simulation model of the current state is developed and the waste in the process is identified.

Stage 4: Document Simulation results

Various scenarios are tested using the simulation model. Improvements in productivity, process time and utilization are achieved.

3.7 Conclusion

The chapter presented the research methodology of this study. The study provided an extensive explanation and description of research methods adopted to achieve the research objectives. The next chapter directs attention to results and deductions of the study.

4 Chapter 4 – Results and Discussion

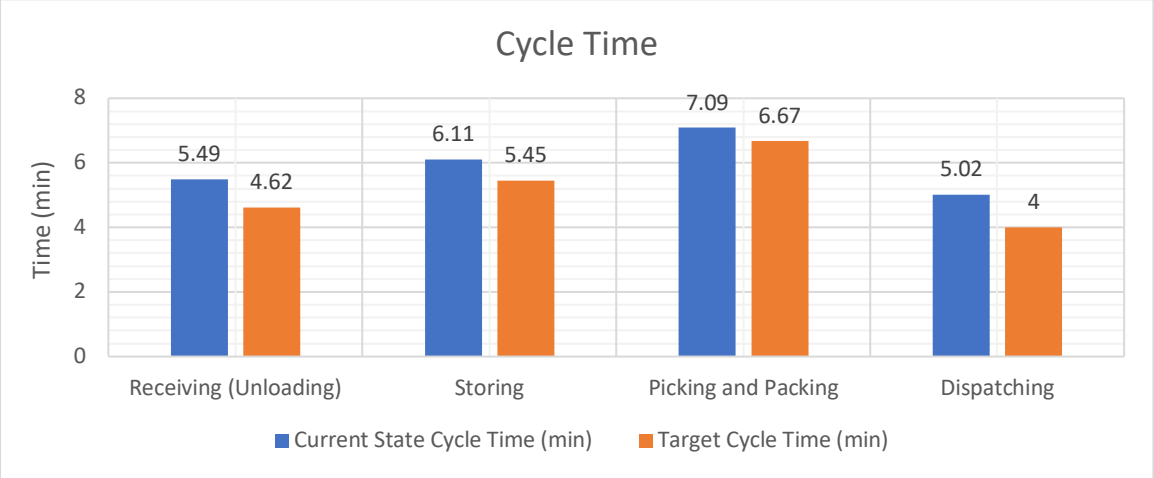
4.1 Introduction

This chapter presents the results of applying lean techniques in the logistics industry and how simulation modelling can be used as a tool to evaluate a logistics process. A comprehensive literature study is conducted so as to answer the research questions by the researcher. Key to the study is to optimize the cycle times and observe the impact on the output. A current state VSM was constructed to identify all processes of the operations in the warehouse. Historical production records and direct observations were used to determine the time spent in the process and bottlenecks. The researcher constructed a simulation model of the warehouse operations. The results are analyzed, and deductions are made.

4.2 Warehouse Value Chain Cycle Time

The warehouse operates for 9 hours per day and 5 days per week. The staff has a lunch break for 30 minutes and two tea-breaks for 15 minutes each. Before the study commenced the researcher was presented with the cycle times at each process center in the warehouse. This is the expected operating performance of each work center. The researcher decided not to use the performance standards because the performance standards were implemented more than 18 months ago. The current cycle time was collected by observation and measurement using a time study. The target cycle time is the operating standard derived from the work measurement exercise conducted more than 18 months by the case study organization and is collected from the process control book in the case study organization. Figure 4 displays the cycle time of the warehouse value chain. As discussed in the previous chapters the processes under consideration is Receiving, Storing, Picking and Packing, and Dispatching.

Figure 4: Warehouse Value Chain Cycle Time



The target process rate at receiving is 13 pallets per hour at 4.62 minutes per pallet. At the time of the observation, there are delays and this is caused by slow response of the scanning device. The researcher found the actual time to be 5.49 minutes per pallet and the following table contains the data collected.

The researcher observed unnecessary stoppages when staff were performing the storing process. This was due to the operators not following the work instruction. The researcher observed the actual cycle time to be 6.11 minutes per pallet and the target rate is 5.45.

During the study, the picking and packing process was observed to be 7.09 per pallet compared to the target of 6.67 minutes per pallet. The shortage of bins caused delays, and this increased the cycle time of the process.

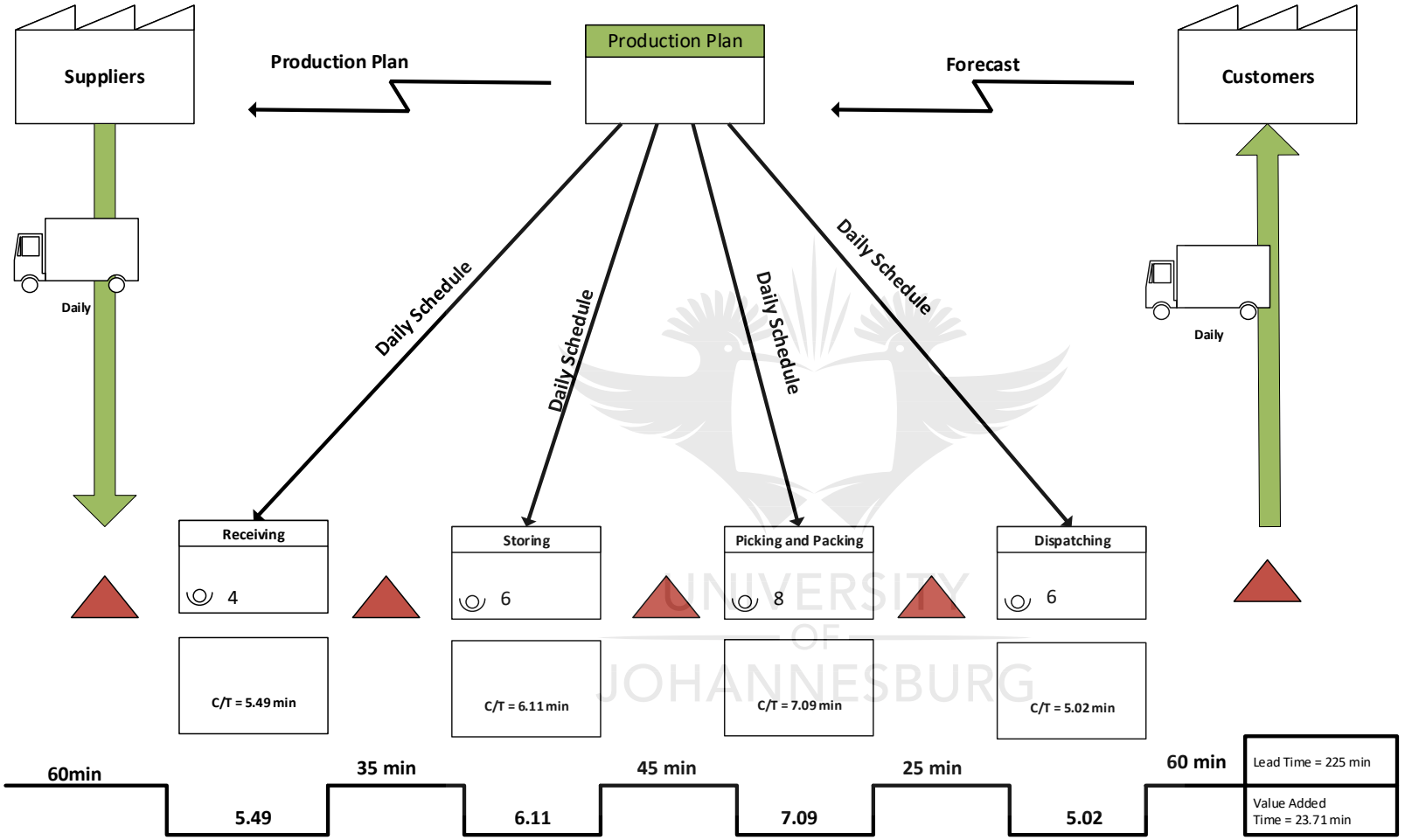
The researcher observed the actual cycle time to be 5.02 per pallet and the target cycle time is 4 minutes per pallet at dispatching process. The slow network caused the delays, and this led to a slow response from the handheld device used to scan out the pallets.

The cycle times measured by the researcher and the operating performance is not the same. This impacts the warehouse operation's capacity to achieve targets. This means the warehouse is processing less items than planned. This is affecting productivity and lead time. The simulation experiment will aim to achieve the operating performance and exceed that target.

4.3 Current State Value Stream Map

The study presents the current VSM developed for operations in the warehouse. The focus was on the operations section of the warehouse. The value chain is broken into work centers and this enabled the analysis of waiting and cycle times. The VSM process enabled the other challenges and bottlenecks affecting the current cycle time to be visualized. The current state VSM presented below illustrates the movement of freight along the value chain.

Figure 5: Current state Value Stream map for the warehouse operation



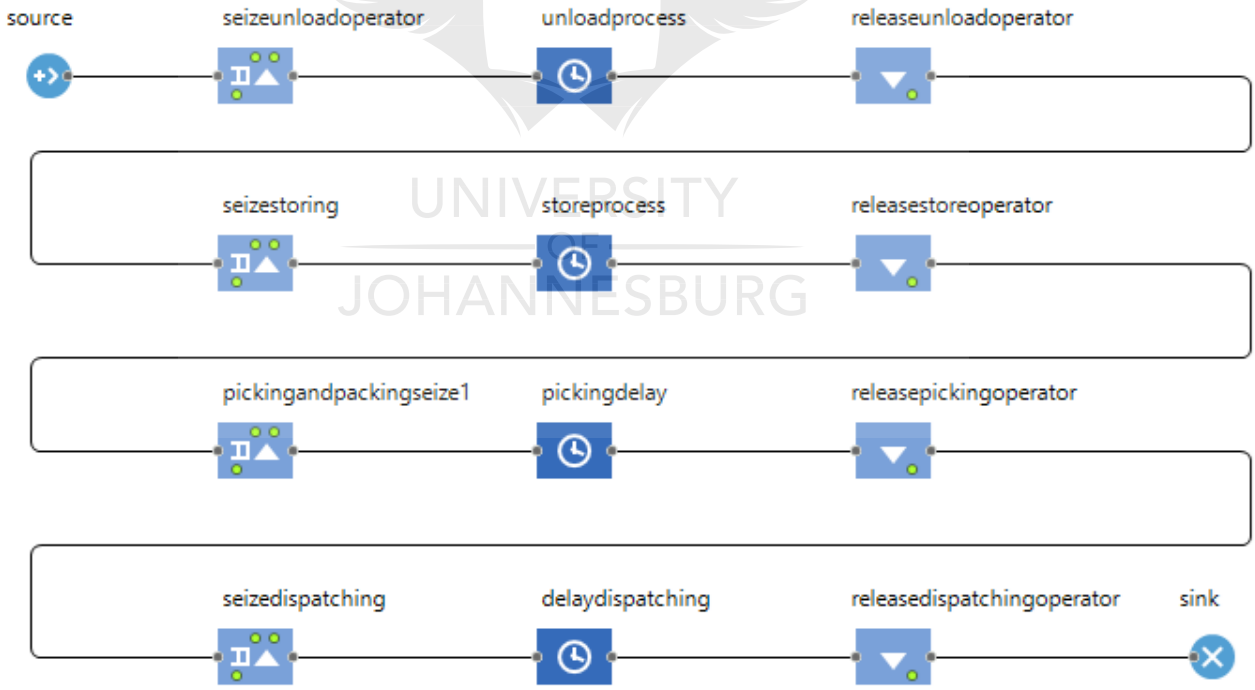
Deductions from the current state Value Stream Map

The study developed the current state VSM as the first stage of lean evaluation. The VSM diagram documents the warehouse process under consideration and waiting time between each process is highlighted in the study. For the study, the VSM displays movement of 1 pallet from receiving through to dispatching. The data is used to develop a simulation model for the warehouse operation. The VSM is important during the early stages as it provides an understanding on the existing anomalies and bottlenecks regarding the cycle time.

4.4 Simulation illustration in Anylogic of the process steps

The snapshot below illustrates the process steps simulation model in Anylogic 8.5.1 University Researcher Edition. The process under consideration for this research are receiving (unloading), Storing, pick and packing, and dispatching.

Figure 6: Process steps in the simulation model



4.5 Simulation Optimization Results

The results of the simulation experiment are presented on Table 1 below. A simulation model only produces a statistical estimate of the performance measure not the measure itself. In order for the simulation estimate to be statistical precise and free of bias. It is recommended to make at least three to five iterations (Bouffard & Briggs, 2019). The simulation results are used to determine the significant variables for optimization. Experiment one (Current) is run at current cycle times and experiment two to ten is run adjusting one variable at a time. One variable will be adjusted while other variables remain at current cycle time.

The results in Table 1 are achieved by creating Smart Logistics Zones (SLZ) in the warehouse operation. The components of SLZ are RFID tags, RFID reader, Warehouse Management System and Mobile devices or electronic handheld devices. The organization was unsure of the suitability and performance of the system. A decision was taken that the installation would be phased in and performance monitored against the current standard.

Experiment one (current) represents the current warehouse performance with manual processes in place. Experiment two is the warehouse performance with the installation of SLZ at the receiving area. This results in the improvement of the receiving by 18% and the overall lead time by 4%. Experiment three is the performance of the warehouse when the warehouse operators are familiar with the new process and the learning rate has peaked. This results in the improvement of the receiving process.

In Experiment four to Experiment seven the SLZ system is installed in the storing and dispatching area. This results in 75% of the warehouse value chain to be automated. An improvement of 18% on the lead time, 27% on the storing and 9% on the dispatching is recorded.

The reason Picking and packing process is automated last, is because the process consumes more resources and has the greatest cycle time in the warehouse value chain. Experiment 8 to Experiment 10 is the performance of the warehouse operation with the installation of SLZ at the Picking and Packing area. The improvement on the Picking and Packing process is 23% and the overall lead time improves by 10%.

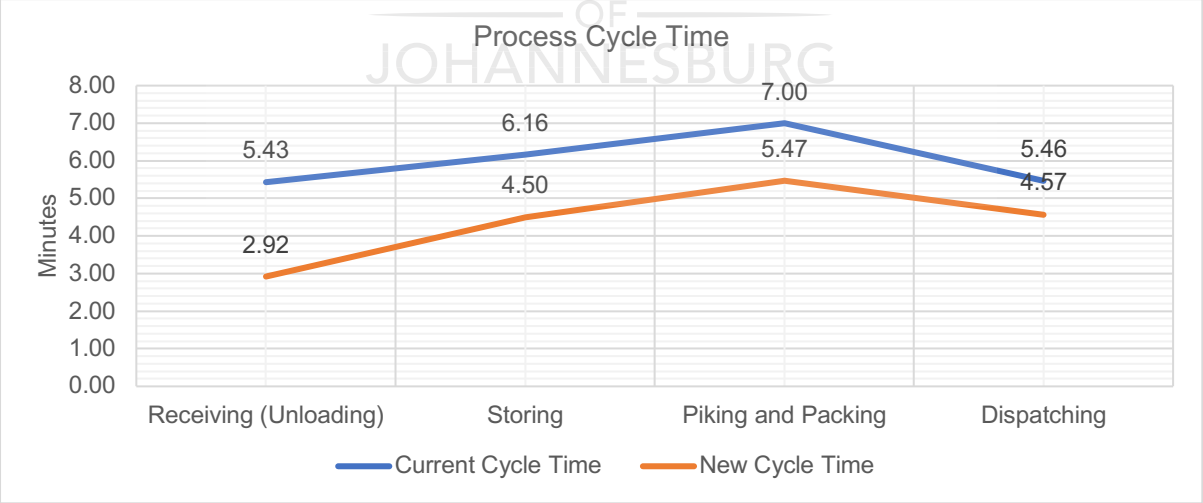
The installation of the SLZ system is justifiable because the system improves the warehouse operation with less manual work, high accuracy in the sorting, improved visibility and planning.

Table 1 Simulation Experiment Results

Process Step	Receiving (Unloading)	Storing	Piking and Packing	Dispatching	Lead Time (minutes)
Current	5.43	6.16	7.00	5.46	24.05
Experiment 2	4.41	6.15	7.01	5.48	23.05
Experiment 3	3.51	6.15	7.02	5.45	22.13
Experiment 4	3.52	5.44	6.44	4.96	20.36
Experiment 5	3.42	4.99	6.45	4.96	19.82
Experiment 6	3.52	4.49	6.46	4.99	19.46
Experiment 7	2.98	4.49	6.46	4.97	18.90
Experiment 8	2.95	4.50	6.46	4.59	18.50
Experiment 9	2.92	4.50	5.47	4.57	17.46
Experiment 10	2.94	4.49	4.97	4.58	16.98

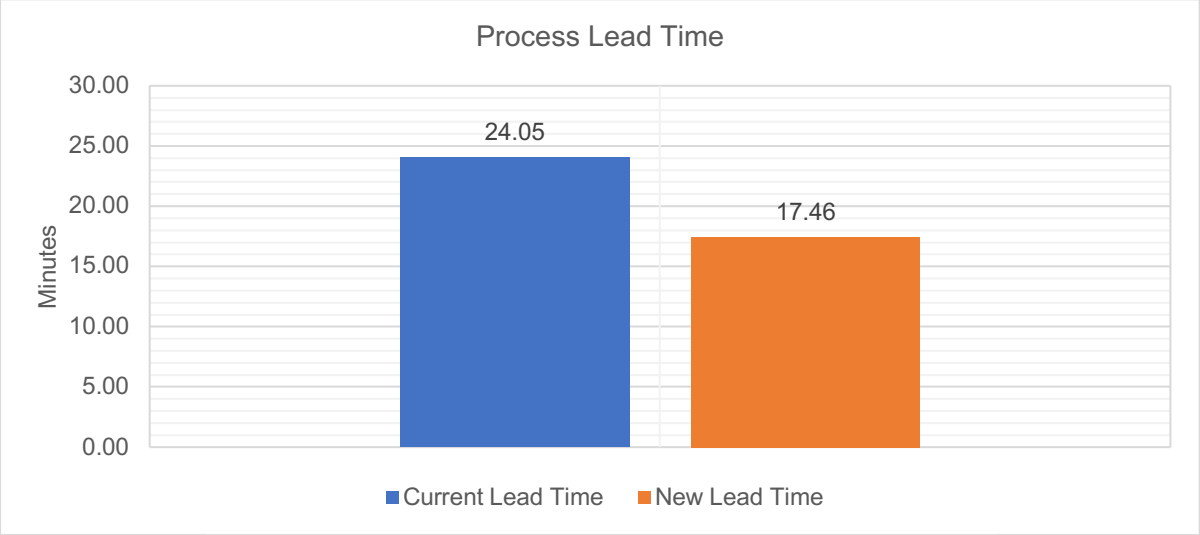
Productivity, operator utilization and cycle time are key outputs in this study. Experiment 9 is selected as the best output when compared against the current operating performance. Figure 7 displays the cycle times of the warehouse value chain current performance compared to the performance of the warehouse value chain when smart factory system is installed. Improved performance is recorded on the cycle times of the warehouse with the smart logistics system. The implication of this improvement leads to increased capacity of the warehouse process capability.

Figure 7: Process Cycle Time



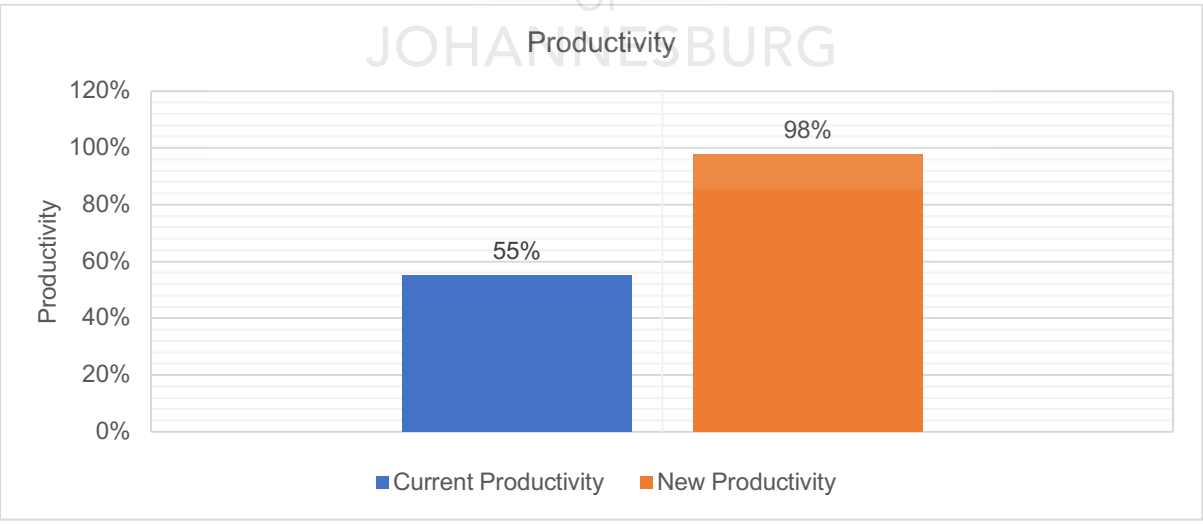
The reduced cycle time leads to a reduction on the lead time. Figure 8 displays the reduction of the lead time from the current performance compared to the warehouse with smart factory system. The reduction in lead time will allow processing of freight to be completed quicker and will ensure that better efficiencies are achieved.

Figure 8: Process Lead Time



Productivity is important to any business. Productivity means businesses are making better use of resources. Figure 9 displays process productivity in the warehouse value chain. In the simulation experiment the current process has 7603 items arriving and 4184 processed. The process with smart factory system has 7734 items arrive and processes 7543. The current productivity is 55% and the productivity of the warehouse with smart factory system is 98%. The improved productivity leads to a reduction in operating cost because more is done with the same number of resources.

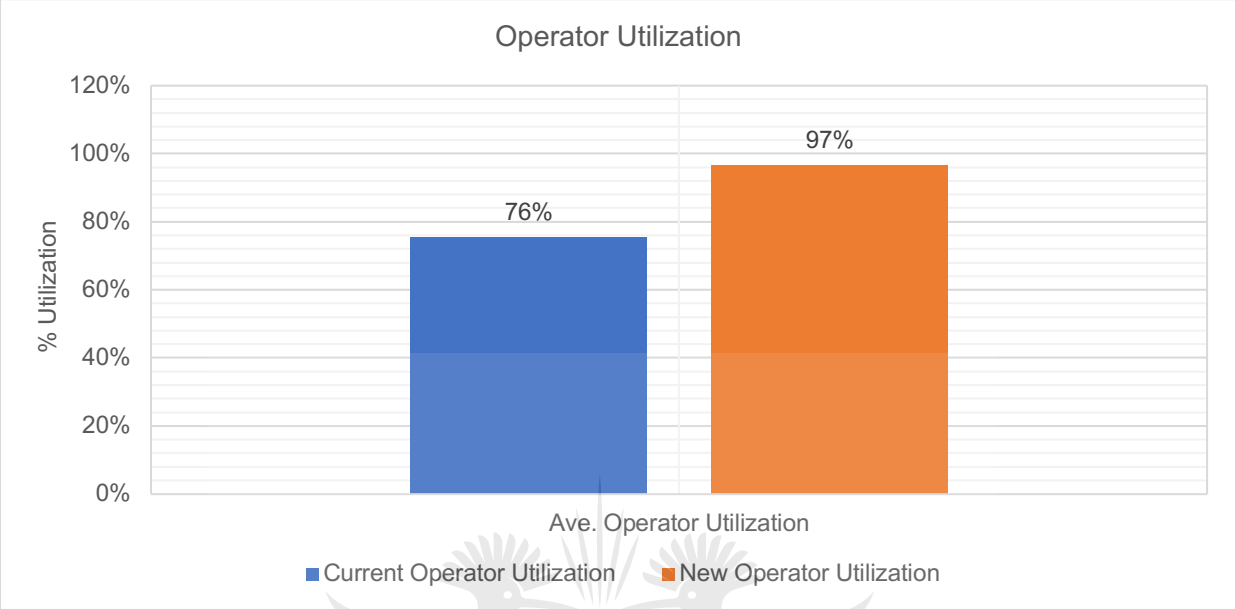
Figure 9: Process Productivity



Operator utilization is a key output in this study and Figure 10 displays operator utilization of the current performance compared to the performance of the warehouse with smart factory system installed. The organization will get greater value from installation smart factory system

in the warehouse because operators will be used effectively and efficiently. This will lead to improved overall warehouse performance.

Figure 10: Operator Utilization



4.5.1 Smart Logistics System component

The smart logistics system consists of RFID tags which are fited onto pallets and goods, RFID readers which reads that data enclosed RFID tags, WMS which stores information on all goods that are processed in the warehouse, and mobile computing used to scan and link pallets to bins. The application of these components creates SLZ within the warehouse operations system.

Receiving

This is the section where palletized goods are received into the warehouse and are attached with RFID tags. The RFID tags contains information about the quantity and the type of goods on the pallet. When the pallets arrive at the receiving section, the RFID reader scans the RFID tag and the information is automatically updated in the Warehouse Management System. Once processed items are then moved into the temporary holding area for storage.

Storing

Palletized goods are transported from the holding area to the storage area. This section is where palletized goods are put-away in storage bins. The RFID tag of the pallet is scanned using a mobile computing device into the bin and the process is concluded by scanning the storage with tag to associate the stored goods with the bin. Because the mobile computing device is connected to the WMS the information instantly updates the WMS.

Picking and Packing

When goods are ordered by customer items need to be picked from storage bins. The items to be picked are sent to the mobile computing device of the warehouse operator. The warehouse operator would initiate the process of picking by first scanning the bin label and scanning all the items to be picked into the trolley. When the sufficient number of items that are scanned out the mobile computing device prompts the warehouse operator that the order is complete, and the items are transported to the dispatching area. The pick task updates the WMS instantly.

Dispatching

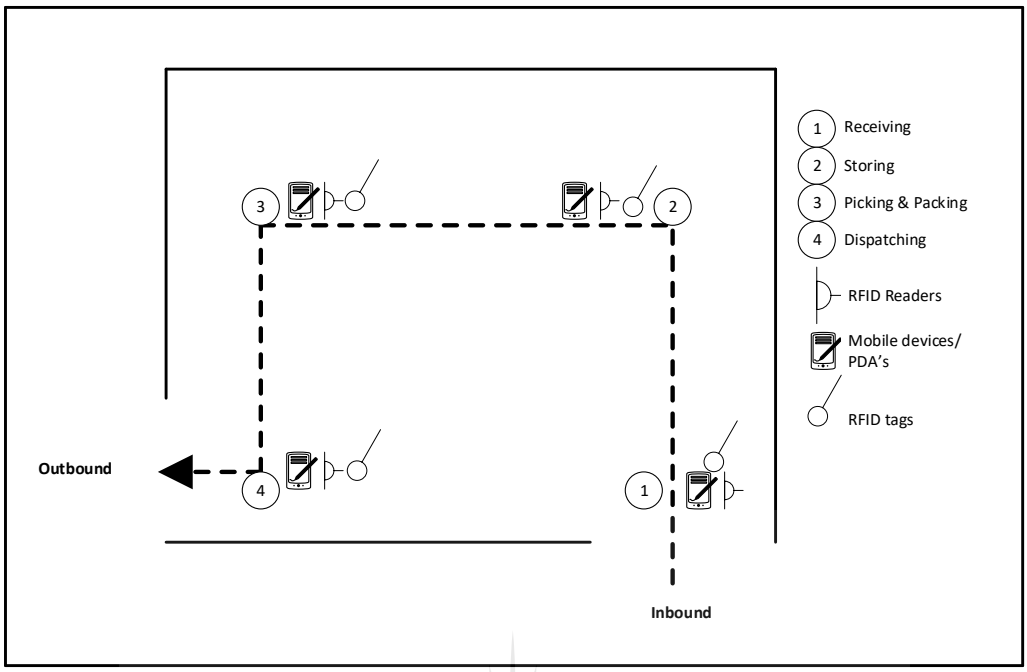
The picked items are received at the dispatching area are placed on a pallet and items are instantly linked into the pallet. When all items for a specific delivery are completed a consignment is generated instantly and the palletized goods are transported to a holding area before they are loaded onto a delivery truck. When palletized goods are loaded in the truck the goods are scanned in by RFID reader and this information updates the WMS which generates an EDI that is sent to the customer with all the contents to be delivered.

The benefits of implementing this system are:

- Process is automated and no paperwork is required. This reduces operating costs.
- Information is readily available
- Improved visibility and high accuracy.

The below Figure 11 is a series of inbound and outbound process of the warehouse fitted with Smart Factory System.

Figure 11 Smart Factory System Value Chain Process



4.5.2 Overall analysis of results

The installation of smart factory system ensures better utilization of resources and increases the capacity of the warehouse value chain. Table 2 displays simulation results of before and after implementation of the smart factory system. The simulation experiment illustrates how the installation of smart factory system improves the performance of the warehouse. The key outputs in this study are improved and this will reduce the unit cost of production.

Table 2 Before and After

Process Step	Current Cycle Time	New Cycle Time
Receiving (Unloading)	5.43	2.92
Storing	6.16	4.50
Piking and Packing	7.00	5.47
Dispatching	5.46	4.57
Lead Time (minutes)	24.05	17.46
Productivity	55%	98%
Ave. Operator Utilization	76%	97%

The study, therefore, recommends the warehouse operation to implement the installation of the smart factory system. These results show how lean tools such as Value Stream Mapping can be complemented by using simulation modelling to evaluate the performance before actual implementation.

4.6 Conclusion

The developed current state VSM of the warehouse operation was presented. The chapter presented the results of the warehouse simulation optimization experiment and outlined how the creation of SLZ will be implemented in the warehouse operation. Tabulated outputs of the productivity, utilization and lead time were presented. The simulation results of the warehouse processes were analyzed, and deductions were made. The next chapter presents the conclusion and recommendations of the study.

5 Chapter 5 – Conclusion and Recommendations

5.1 Introduction

This chapter provides the conclusion of the study, reflecting the findings against the research objectives. The study constitutes three research objectives. The first was to determine the role of logistics in a global organization. Secondly, to determine the relationship between applying continuous improvement and adoption of technology in enhancing competitive advantage in logistics. Lastly, can a simulation tool be adopted to achieve logistics optimization.

a) The role of logistics in a global organization.

The study, in the literature review chapter, discussed the origins of logistics to logistics in the 21st century. The chapter discussed the impact of logistics on ensuring customer's requirements are met, optimization of the supply chains and, the importance of logistics in the growth and economic development of a country.

b) To determine the relationship between applying continuous improvement and adoption of technology in enhancing competitive advantage in logistics.

The study discussed continuous improvement methods in the chapter of the literature review. Value Stream Mapping as a Lean tool was discussed in the literature review and was used effectively as part of the research methodology to address the research objectives.

The study, in the literature review chapter, discussed information technology in logistics. The chapter discussed how the adoption of information technology enhances a competitive advantage for a global logistics organization. Information technology allows participants in the value chain to be connected in real time and, makes it possible for all the linkages in the value chain to coordinate and integrate processes.

The results of the simulation experiment illustrate that if continuous improvement methodologies are implemented with technology, the warehouse performance improves. Productivity, cycle time and operator utilization all improved with the installation of smart logistics zones.

The benefits of adoption technology are: Process is automated and no paperwork is required. This reduces operating costs. Information is readily available, improved visibility and high accuracy.

c) Can a simulation tool be adopted to achieve logistics optimisation?

The study discussed simulation modelling as part of the literature review and Anylogic 8.5.1 University Researcher Edition simulation software was discussed in the research methodology to address the research objectives.

The study employed a case study of warehouse operations in a global logistics organization as part of the research methodology. The researcher incorporated the warehouse operation into a simulation model with the aid of a current state Value Stream Map. An optimization experiment was designed to observe the cycle times and outputs in the simulation model. The experiment proved that applying continuous improvement methods and adoption of technology does enhance a competitive advantage in logistics. The results obtained from the simulation experiment provides evidence that Value Stream Mapping can complement tools such as simulation to evaluate the impact of warehouse automation before actual implementation.

This simulation experiment illustrates that simulation modeling can be competent in testing the impact of implementing continuous improvement methodologies with technology on the productivity of the warehouse. The results obtained from the simulation experiment provide evidence that Value Stream Mapping can complement tools such as simulation to evaluate the impact of warehouse automation before actual implementation.

5.2 Suggestion for future research

The study provides a particular focus on warehouse operations. A more integrated and holistic approach with an expanded scope for the entire warehouse operation including the support functions. The researcher suggests that future research should include the cost of acquiring the entire Smart Logistics Zone system to evaluate the feasibility of adopting the Smart Logistics Zone system. An in-depth analysis of the variables like cycle time on a particular process helps understand exactly where intervention is required to achieve performance. The study allows to choose the type of smart technology required with due interest in integrating the entire chain.

5.3 Conclusion

This chapter concluded this research with an overview of research objectives, recommendations and suggestions for future work is also presented.

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