

UNIVERSITY OF KWAZULU-NATAL

TITLE

Inventory management in the electricity industry in South Africa: A case study

By

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DECLARATION

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ABSTRACT

Electricity remains one of the most important technological innovations in human history, because of its importance to modern daily life, both domestically and industrially. In South Africa, Eskom Holdings is the state-owned power company responsible for generating, transmitting and distributing electricity. Eskom's material management department deals with the planning and ordering of materials and their transportation to the regional distribution centres (warehouses). This department is expected to contribute to the company's business goal of providing sustainable electricity for a better future. However, inept decision-making processes at Eskom have led to a number of problems associated with inventory. These costly problems diminish the material management department's efficiency and hence the company's ability to reach its goals.

This study used qualitative research to investigate the inventory management in Eskom's KwaZulu-Natal (KZN) cluster with a view to identifying those decisions and actions responsible for such inventory anomalies. A conceptual model of inventory management was used to structure this research. This model emphasises the way in which managers' decisions are influenced by the context in which the supply chain operates. The research objectives were to examine the impact of demand, the supply chain structure, information availability and Eskom's business goals on how inventory decisions are made, and to understand the effects of this decision making processes.

The major finding was that the department has a significant problem of unbalanced stock, with an excess of certain items and shortages of others in all its six regional distribution centres in KZN. This inventory challenge facing the company was found to be caused by inadequate forecasting, poor information sharing, poor housekeeping, large quantities of inventory returns from projects and the disorganised scheduling of deliveries. The study also found that there is a gap in the system of classification of inventory in Eskom which adversely affects the management of inventory. Recommendations include replacing the economic order quantity system with a periodic order quantity system and incorporating elements of lean into the management of inventory. Furthermore, improving the information available to material requirement planners so that purchasing is responsive to customer demands will reduce the burden of inventory that is not required and ensure the availability of stock as it is needed.

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CHAPTER 1: INTRODUCTION

1.1 Introduction

In any organisation that provides tangible goods to its customers, the management of inventory is of paramount importance. The decision-making of most organisations is predicated on the accessibility and sustainability of production materials. Eskom is South Africa's state owned electricity company and is the focus of this study. The study investigates the management of inventory in Eskom within the operating unit in KwaZulu-Natal province, in South Africa. This introductory chapter presents the background and the research problem. It provides the outline of the research questions and objectives, and describes the conceptual framework of the study. The chapter also provides an overview of the research design and methods applied.

1.2 Background of the study

The background to the study provides the underpinning issues that gave impetus to this study. It is the preliminary step in which the area being researched is reviewed to establish what is known about the research issue and what the history of the research problem is.

Inventory comprises all goods and materials that are required by companies for the purposes of creating and distributing products (Fogarty, Blackstone & Hoffmann, 1991, p. 156). Therefore all raw materials, components parts, sub-assemblies and finished products in the supply chain are regarded as inventory. Effective management of this inventory is important for organisations because it ties up capital, requires storage space, needs handling, may deteriorate, becomes obsolete, and may be lost or stolen, (Fogarty et al., 1991, p.156). Moreover, if a business does not manage inventory efficiently and effectively it will end up having shortages of required items, excessive stock of others or even having items that are not required at all (Fogarty et al. 1991, p. 157).

Eskom Holdings is a state owned company responsible for the generation, transmission and distribution of electricity in South Africa as well as to neighbouring states. It was established in 1923 as a government-owned utility, the Electricity Supply Commission, and existing private utilities were later closed down (Gaunt, 2008, p. 3448). It supplies electricity directly to mines, other large industries and rural consumers while municipalities act as re-distributors to urban customers (Gaunt, 2008, p. 3448). Eskom has regional material management

departments that deal with the planning and ordering of materials and their transport to the regional distribution centres (warehouses). The material management department needs to contribute to the company vision of providing sustainable electricity for a better future by ensuring that the right inventory is made available at the right time and in the right place so that field services or project teams receive the required material in order to maintain the supply of electricity to Eskom's customers.

The purpose of this study was to investigate features of Eskom's inventory system that result in inefficiencies within the Distribution Division. Therefore, Eskom's demand forecasting, supply chain structure, warehouse management and inventory decision making processes were assessed. This case study focuses mainly on the management of inventory in Eskom's KwaZulu-Natal Operating Unit which is termed 'Cluster Five'. It has been observed that the cluster has a significant problem of excessive stock in all six regional distribution centres. These include inadequate forecasting, poor housekeeping, unwanted deliveries, and large quantities of inventory returns from projects and disorganised scheduling of deliveries.

1.3 Research problem

Poor decision-making processes at Eskom have led to a number of problems associated with inventory. These problems are costly and also affect the company's ability to provide quality services to its customers. This research investigated the nature of inventory in the company's KwaZulu-Natal cluster and attempted to **identify the decisions and actions** that lead to these inventory problems and hence **provides recommendations** for improvements to the current processes.

1.4 Overview of literature

1.4 .1 Inventory policy

Businesses keep inventory in order to meet the demand from their customers at any particular time (Zappone, 2014, p. 1). The management of inventory is an important aspect of the supply chain because in many businesses inventory represents a major cost. Policies and procedures must be developed to guide managers as to when an order should be placed for a particular product and how large the order should be (Jalali & Nieuwenhuyse, 2015, p. 1217). The replenishment policy must take cognisance of the costs and service levels that are associated with inventory (Mo, Tseng & Cheung, 2014, p. 1296). While many academic

studies focus on optimisation (Jalali & Nieuwenhuys, 2015, p. 1218), practitioners often use other techniques, such as heuristics (rules of thumb) (Davis, 2016, p. 88). Developing order fulfilment strategies is also imperative, since different parts may need to be grouped together for particular jobs (Mo et al., 2014, p. 1297). Furthermore, managers at Eskom must follow the procurement procedures laid down in the company procurement policy.

1.4.2 Inventory systems

Different ordering systems, such as the economic order quantity (EOQ), periodic order quantity (POQ) and economic production quantity (EPQ) models, may be used to control the amount of inventory held by allowing managers to calculate how much to order and by when the order should be made, (Tsao, Liao & Sun, 2013, p. 401; Harrison, van Hoek & Skipworth, 2014, p. 214; Schonberger & Schniederjans, 1984, p. 78).

The ABC Inventory classification system allows different types of inventory to be managed according to their value to the company (Jamshidi & Jain, 2016, p. 52; Mpwanya, 2005, p. 15). In recent years, there are numerous multi-criteria inventory classification techniques that have been presented as alternatives to this method in order to take more factors, such as lead times, into account (Millstein, Yang and Li, 2014, p. 72). Further refinements of this type of classification include taking into account how important it is to avoid stock outs of different items (Mpwanya, 2005, p. 16).

Just-in-time (JIT) seeks to minimise inventory by ensuring that materials are delivered as they are needed (Schonberger & Schniederjans, 1984, p. 77). Although this approach may represent an ideal, buffer stocks are usually necessary in case things go wrong.

1.4.3 Inventory problems

Some common problems of inventory in supply chains are:

- Push scheduling in which materials are sent by providers regardless of whether they are needed (Harrison et al., 2014, p. 225).
- Bulk purchasing may deliver cost savings per item but causes a build-up of inventory (Christopher, 2011, p. 230).
- Long lead times create problems when demand is unpredictable thereby increasing the requirement for buffer stock (Harrison et al., 2014, p. 226).

- The so-called “bull-whip effect” by which small changes in demand are increased as the demand is transmitted backwards through the supply chain (Harrison et al., 2014, p. 222).

1.5 Conceptual framework

The conceptual framework represents the researcher’s belief of which variables are relevant to the research problem and how they are related to each other (Sekaran & Bougie, 2016, p. 82). The conceptual framework used in the study was based on the model of inventory management developed by Haines, Hough and Haines (2010, p. 113). They ascertained empirically how access to information about consumer demand and about undelivered orders impacts on decision makers’ procedural rationality (Haines et al., 2010, p. 112). This is defined as the “extent to which the decision process involves the collection of information relevant to the decision and the reliance upon analysis of this information in making the choice” (Dean & Sharfman, 1993, p. 1071 cited in Haines et al., 2010, p. 112). These authors argued that in a supply chain the decisions that are made are a function of an individual’s cognitive processes as well as the business environment and organisation in which they find themselves.

This perceptual approach to supply chain decision making corresponds most closely to the cognitive lens perspective described by Rajagopalan and Spreitzer (1997, p. 62) in their study of frameworks for strategic change, but with elements of the learning lens perspective. This is in contrast to the rational lens perspective which assumes that decisions are made simply based on the optimisation of the firm’s processes as a reaction to changes in its environment, thus ignoring the role that managers play as individuals (Rajagopalan & Spreitzer, 1997, p. 55). These authors subsequently developed an overarching theoretical framework of strategic decision-making (SDM) (Rajagopalan, Rasheed, Datta & Spreitzer, 2012, p. 229) ‘which draws on the linear, adaptive, and interpretive views of strategy’. The distinctiveness of this model of inventory management is its focus on the application on decision-making within a supply chain that transpires in a particular operational setting and takes into account the human element (Haines et al., 2010, p. 113).

The model highlights the way in which managers make decisions based on individual perceptions and how those decisions are tantamount to ordering inefficiencies which consequently impact on the inventory levels and customer service, and the effects of feedback

from the outcomes on onward decision making processes. The model affirms that the influences on inventory management decisions are demand, supply chain influences, information availability and business goals. The aforementioned variables are relevant to this study and this is the justification for adopting this conceptual model for the purpose of this research. Furthermore, the model is apt for the study to explain how the decisions made by managers at Eskom result in the outcomes such as those described by Haines et al. (2010, p. 113), as well as those feedback effects that occurred thereafter. The model factors are described further in Chapter 2.

1.6 Research questions

The research questions that will be asked in this study are:

- What are the features of Eskom's inventory system?
- How does Eskom integrate demand from its project teams into the management of inventory?
- How does Eskom's supply chain structure influence the management of inventory?
- How does the availability of information affect Eskom's management of inventory?
- How do Eskom's business goals affect decision-making in materials management?
- How can the decision making processes affecting inventory management at Eskom be improved?

1.7 Research objectives

The objectives of this study are:

- To investigate the features of Eskom's inventory system.
- To ascertain how Eskom integrates demand from its project teams into the management of inventory.
- To determine how Eskom's supply chain structure influences its inventory management.
- To understand how information availability affects Eskom's management of inventory.
- To determine whether Eskom's business goals affect decision-making in materials management.

- To provide recommendations for improvements to the decision making processes affecting inventory management at Eskom.

1.8 Overview of methodology

This study sought to generate locally appropriate theory (Ketokivi & Choi, 2014, p. 234). Therefore the research design took the form of an exploratory case study (Sekaran & Bougie, 2016, p. 98). Using a qualitative research method, data were collected through in-depth interviews (Sekaran & Bougie, 2016, pp. 113,121). Furthermore the researcher conducted document analysis of inventory practices in the warehouses to provide an understanding of how the inventory management system is meant to work (Sekaran & Bougie, 2016, p. 126). The researcher used non-probability, purposive sampling where the participants were selected based on the information they could provide. There were in-depth interviews with the supply chain operations employees, procurement employees and electrification/project employees within Eskom. The researcher used content analysis to analyse the data collected with in-depth interviews, and the documentary data that was collected (Sekaran & Bougie, 2016, p. 350).

1.9 Significance of study

Inventory decisions carry a considerable risk for organisations and have a significant impact in the supply chain (Bowersox, Closs & Cooper, 2010, p. 282). These decisions include the level of inventory that the organization must keep and which it must match with the demand in order to satisfy orders for customers (Kotler & Armstrong, 2015, p. 397). Holding inventory has financial implications for an organisation and hence this is a critical area for Eskom since the company is experiencing a financial crisis. This study is important because it discusses Eskom inventory management system and procedures, its weaknesses then recommend how it could be improved. This will be helpful to Eskom Material Management Department in KwaZulu Natal, and it may also create awareness to other Eskom's geographic clusters.

1.10 Conclusion

The study set out to examine the inventory management in Eskom within the KwaZulu-Natal operating unit. Therefore, this chapter discusses the background to the research and the research problem in relation to the management of inventory in Eskom. The chapter

introduces the research questions and the research objectives, and describes the conceptual framework used to guide the study. It also provides an overview of the research design and methods employed. The following chapter focuses on a review of relevant literature that provides further background and context to the study.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter presents the literature review for this study. The aim was to situate the study within the obtainable related academic discussions (Boote & Beile, 2005, p. 3). It demonstrates how this research links with the broader scholarly debates on the subject under investigation, to validate its significance to the general pool of knowledge (Pather, 2004, p. 72), and to establish the study gap and fill it (Kumar, 2011, pp. 31-32; Vithal & Jansen, 2004, p. 14). Somekh and Lewin (2011, p. 17) confirmed that the main aim of a literature review is “to put your research project into the context by showing how it fits into a particular field”. Thus, a good literature review goes beyond mere listing of preceding scholarly work (Paltridge & Starfield, 2007, p. 101). According to Stilwell (2000, p. 173), the “literature review needs to indicate the different views, agreements, disagreements and trends of thought on the topic of research and be accurately portrayed and acknowledged in the text”. Therefore, a well prepared literature review constructs a strong basis for the whole research (Bowers & Stevens, 2010, p. 94). In fact, the construction of the theoretical foundation of a research project is imperative for the identification and explanation of concepts, and for the selection of research tools and methodology (Kumar, 2011, p. 31). Therefore, this literature review was meticulously carried out to reflect the ongoing debates on inventory management and control. It reviews some of the extensive literature on managing inventory which is one of the critical factors in the cost structure of most companies.

This chapter will discuss the information that already exists in the field of inventory management, by displaying the correlation between preceding studies. This will be done by starting with the concept of procurement and supply, then moving to logistics communication, inventory management, risk of inventory, inventory policy, inventory systems (ABC Classification, Just-In-Time inventory management, lean systems, ordering models), order processing, warehouse management, warehouse and storage design (warehouse site selection, warehouse layout, material handling) and reverse logistics. The conceptual framework will also be discussed in this chapter by presenting four concepts such as demand, supply chain influences, information availability and business goals.

2.2 Procurement and supply chain

The procurement function includes sourcing material from potential suppliers, carrying out the purchasing process and ensuring that delivery takes place (Mangan & Lalwani, 2016, p. 76). The literature indicates that supply chain management comprises procurement, production, inventory management, transportation between the participants in the supply chain and delivery to the customers that are being served (Hugos, 2011, p. 4). Supply chains are complex because their management requires the integration of multiple processes and stakeholders. Moreover, this complexity has increased with the rapidly evolving digital transformation and globalisation of trade (Presutti, 2003, p. 220). The procurement function has become correspondingly challenging as the pressure to obtain supplies rapidly is often accompanied by greater geographic distances between suppliers and purchasers.

The procurement process begins when there is a buying need, and that need should describe the buying requirements that originate in the demand from the final customer, (Presutti, 2003, p. 220). Technological innovation, such as the introduction of e-procurement, has delivered improvements in terms of more efficient flows of information, finance and physical goods (Piera, Roberto, Giuseppe, & Teresa, 2014, p. 8). E-procurement is an online process, and it assists companies to save money and time, manage inventory better and hence achieve improved efficiency throughout the supply chain (Piera et al., 2014, p. 10). Procurement is also one of the functions in the company that significantly influences supply chain sustainability by ensuring that suppliers conform to environmental and social standards (Niu, Chen, & Zhang, 2017, p. 81).

According to Ottemöller & Friedrich (2017, p. 2), a supply chain is “a network of connected and interdependent organisations mutually and co-operatively working together to control, manage and improve the flow of materials and information from suppliers to end users”. The procurement function is central to these two flows and plays a critical role in the collaborative relationships that support an effective supply chain. Hugos (2011, p. 10) added that the objective of supply chain management is to increase demand by increasing sales to the end-customer while improving the efficiency of production by reducing inventory and operating expenses.

2.3 Logistics communication

Whereas logistics was previously considered to be a support activity, in modern supply chains it has a strategic function and is a source of competitive advantage. Effective communication is needed to support logistics networks (Muhammad, Saahar, Hasan, Fiah, & Nor, 2014, p. 204). Communication, or the sharing of information with partners in the supply chain, is essential in order to match supply with demand (Gabler, Agnihotri and Moberg 2014, p. 1). The growth of logistics management has enabled production and distribution companies to gain more access to the global market and to improve their competitiveness (Muhammad et al., 2014, p. 205). Globalisation has presented challenges to logistics companies that must ensure that the products are transported safely from one point to another (Martí, Martín, & Puertas, 2017, p. 170). Effective logistics communication reduces the risks of this function and hence reduces costs when material is moved between countries (Martí et al., 2017, p. 170).

2.4 Inventory management

Businesses keep inventory, of the production materials or of the finished product or both, in order to meet the demand from their customers at any given time (Zappone, 2014, p. 1). However, this necessitates the formulation of effective procedures capable of minimizing undue stockpiling, wastage and loss and the costs associated with them. According to Mangan and Lalwani (2016, p. 167), good inventory management is a process to maintain flow and avoid delays in the supply chain. When an organisation decides to operate through more than one distribution channel the risk associated with inventory is increased (Bowersox et al., 2010, p. 285). Milondzo and Mashau (2015, p.140) indicated that managing inventory is about ensuring that all required materials of the organization are traceable and accounted for within the operational networks. Viable organisations consider inventory as a major asset since it is expected to provide return for capital when customers have paid for goods and services (Bowersox et al., 2010, p. 285). Inadequacies were observed at Eskom regarding its inventory management: these observations gave impetus to this study. The inventory management system of Eskom needs to be investigated in order to ascertain the causes of inefficiencies, and to recommend some policies for possible improvement that could reduce losses and help to maximise profit.

2.5 Risks of Inventory

Keeping inventory is risky; therefore it is important for managers and officials within the organization to be acquainted with the skills and knowledge of managing inventory (Milondzo & Mashau, 2015, p. 141). The inventory decisions have an influence over the entire business process, because inventory impacts on the operations of an organisation and directly influences the activities that take place within the supply chain (Bowersox et al., 2010, p. 282). When inventory decisions are being made the business must ensure that they are driven by the needs of the customers. Inventory system planning is critical, especially in manufacturing businesses, because material shortages can result in the shutting down of a production process or force the schedule to be altered, which may result in escalation of the costs of production and possible shortage of the finished goods (Bowersox, et al., 2010, p. 157). The organizations that keep inventory are operating at risk as they may suffer from financial loss if it is not properly managed. It becomes more risky if the organisation keeps hazardous inventory (waste) as it poses threats to people and environment when it is transported to warehouses or to final customers (Zhao & Ke, 2017, p. 136). The management of such risks is feasible by the use of a good inventory system.

2.6 Inventory policy

Inventory policy comprises guidelines that indicate what to buy or make, in what quantity and suggest the best time to do so (Bowersox et al., 2010, p. 286). Policies and procedures are developed to guide materials managers as to when an order should be placed for a particular material and how large the order should be (Jalali & Nieuwenhuysse, 2015, p. 1217). Therefore, an inventory policy is a strategic measure to monitor and control the flow of operational materials in a given organisation. For example, by the use of an inventory policy, an organisation may choose to postpone material positioning and maintain stock at the manufacturing facility, and another organization may decide to use a more speculative policy by choosing to position more material or products in a regional warehouse so that they are closer to the customers. A replenishment policy must take cognisance of the costs and service levels that are associated with inventory (Mo et al., 2014, p. 1296).

Inventory policies are usually determined by the classical models for inventory management and they are easily implemented (Garcia-Herreros, Agarwal, Wassick & Grossmann, 2016, p. 256). However, Bowersox et al. (2010, p. 287) argued that the development of good

inventory policies is the most difficult issue within the overall inventory management. Once sound inventory policies are in place and are well implemented, the costs of keeping inventory will be minimised because the required inventory will be available as needed (Mo et al., 2014, p. 1297). The optimum risk management of materials is embedded in the inventory policy of the organisation and it should be formulated as the internal control system of a supply chain, to focus on risk minimisation.

2.7 Inventory Systems

Organisations are required to have an effective inventory management system in order to meet the demand of their customers and to improve their services for greater competitive advantage in the marketplace (Zhao & Ke, 2017, p. 123). There are different inventory systems that businesses could utilize to manage and control the level of inventory, such as ABC Classification, Just in Time/Lean Systems, Economic Order Quantity (EOQ), Periodic Order Quantity (POQ) and Economic Production Quantity (EPQ) models (Tsao et al., 2013, p. 401; Harrison et al., 2014, p. 216; Schonberger & Schniederjans 1984, p. 78).

2.7.1 ABC Classification

ABC analysis is the most common technique that is used in managing inventory, whereby inventory is categorised into three groups; group A comprises the most essential items, group B comprises the items of intermediate importance and group C contains less important items (Douissa & Jabeur, 2016, p. 550). The ABC inventory classification system allows different types of inventory to be managed according to their value to the company (Jamshidi & Jain, 2016, p. 52; Kruger & Ramphal, 2009, p. 200; Mpwanya, 2005, p. 15). The A items are critical and they should be given the highest priority. In this category, stock outs are not permitted and these items may be kept in a lockable area in the warehouse. B items follow, where stock outs are partially accepted and tight control on these items is also required although not at the same level as the A items. Finally C items are those where stock outs are permitted and there is moderate control on these items.

ABC categories are usually based on monetary value and amount used annually, with the Pareto, or 80:20, rule dictating that the 20% with the highest value fall into the A category, the next 30% into B and the 50% with the lowest rand usage value into C (Millstein et al., 2014, p. 71). In recent years, there are numerous multi-criteria inventory classification techniques that have been presented as alternatives to this method in order to take more

factors, such as lead times, into account (Millstein et al., 2014, p. 72). The cost of inventory may be calculated in different ways including the different costs of materials, the differences in the potential earnings from different materials and lastly the varying cost of stock outs for materials.

2.7.2 Just-In-Time Inventory Management

Just-in-time (JIT) seeks to minimise inventory by ensuring that materials are delivered as they are needed (Wild, 2002, p. 59). Although this approach may represent an ideal, buffer stocks are usually necessary in case things go wrong. Kruger and Ramphal (2009, p. 193) indicated that in a JIT system the required quantities are delivered in the right time, at the right place, and obviously when that happens there is no need for the business to have warehouses since material will go straight where it is needed. JIT is a focus of material planning since it has been particularly successful in Japanese supply chains (Vrat, 2014, p. 23). Furthermore, the company with successful JIT is able to provide any material needed, wherever, whenever and just in time with 100% of delivery assurance of all inventory without keeping stock on hand (Vrat, 2014, p. 23). However, this system requires a high level of organisation and control across the supply chain (Wild, 2002, p. 61).

2.7.3 Lean systems

The lean production system was developed by the Toyota Motor Company and became known as the Toyota Production System (TPS). The term *lean* was coined in the book *The Machine that Changed the World* (Womack, Jones & Roos, 1990). While it was initially applied to large-scale manufacturing companies, the lean approach has been found to be valuable in almost all types of businesses, including public utilities such as Eskom (Prashar, 2016, p. 479). This system incorporates sets of approaches and tools with the aim of eradicating the seven forms of waste (Muda) and increasing profits through cost reduction (Wagner, Herrmann, & Thiede, 2017, p. 126). These practices usually include JIT supply management but also provide tools for the management of the manufacturing process which can also be useful in warehouse systems. Lean manufacturing concentrates on what generates value for customers (Omogbai & Salonitis, 2016, p. 106).

A production system incorporates the multifaceted interrelations of its technical and human components and hence forms a socio-technical system (Wagner et al., 2017, p. 125). The wastes identified in the lean approach are: transportation, inventory, motion, waiting, overproduction, over-processing and defects (Resta, Powell, Gaiardelli & Dotti, 2015, p. 15).

The tools that are used in the production system include 5S (housekeeping), Kaizen (continuous improvement), Just-In-Time, Heijunka (level scheduling), Pull flow, standardisation and teamwork (Wagner et al., 2017, p. 127). Figure 2.1 shows the House of Lean which illustrates the principles of lean production.

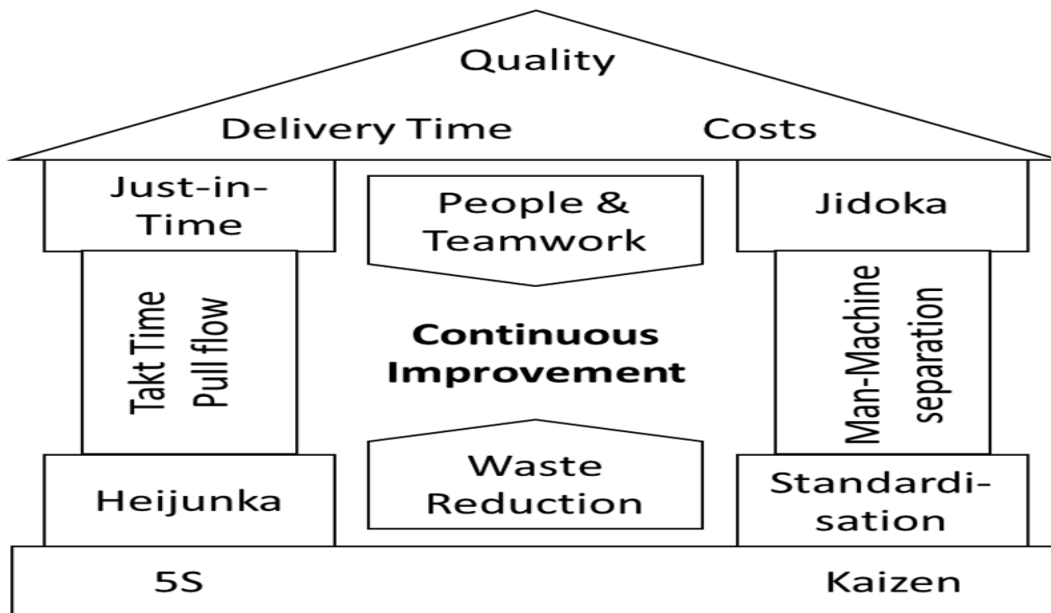


Figure 2.1. House of Lean Production System, (Wagner et al., 2017, p. 126).

2.7.4 Ordering models

There are different kinds of ordering systems but the most commonly used one is the economic order quantity (EOQ) which balances the cost of holding inventory against the ordering cost (Ventura & Samuel, 2016, p. 113). When ordering costs are high, this increases the inventory that is held. To reduce the size of the EOQ, these costs must be reduced (Harrison et al., 2014, p. 217). The shortcomings of the EOQ system, for example where the supply is unable to match the demand if it increases suddenly, mean that other ordering methods may be needed (Harrison et al., 2014, p. 217). Alternatives to EOQ include periodic order quantity models or economic production quantity models. These allow businesses to respond when the demand is variable and the economic order quantity is unable to meet the demand.

Periodic order quantity (POQ) bases the number of units that needs to be ordered on the demand over a fixed period of time but incorporates the EOQ when deciding what this length of time should be (Harrison et al., 2014, p. 218). The POQ is reviewed regularly, hence this system is used when the material or inventory that should be needed does not exhibit even

demand (Kadric, Bajric, & Pasic, 2015, p. 306). Economic production quantity (EPQ) is the model that is used by manufacturing companies to determine the best production level that reduces the inventory cost. Companies apply this system to the products or material that are produced internally instead of obtained from outside suppliers (Taleizadeh, Niaki, & Najafi, 2010, p. 1384).

Periodic review methods determine the quantity to be ordered at certain intervals by assessing the stock on hand and comparing it to a target stock level. Lead times for orders must also be taken into account (Harrison et al., 2014, p. 219).

2.8 Order processing

Order processing requires information from customers to be conveyed upstream through the supply chain so that distributors, manufacturers and suppliers can ensure that product flows downstream to meet customer demand (Hugos, 2011, p. 82). While the ordering process has traditionally depended on the use of telephone and physical documents such as purchase orders (generated by distributors), picking tickets (generated by suppliers in order to fill orders) and invoices (which call for payment between supply chain partners), many of these items are now generated electronically (Hugos, 2011, p. 82). The logistics industry and retail industries have experienced changes that came with the digitization and the rise of e-commerce, with corresponding changes in purchasing habits and customer expectations (Leung et al., 2018, p. 386). If the company is using e-commerce, and promises that deliveries will be carried out the next day or even the same day, this may result in high levels of stress on order fulfilment processes (Füßler & Boysen, 2017, p. 150). The traditional warehouse structure follows the picker-to-parts model, whereby pickers move between the shelves collecting the requested orders according to the stock keeping units (SKUs) (Füßler & Boysen, 2017, p. 150). However, this may not be efficient enough and alternative strategies, such as automation, may be required to match the efficiency of automated order processing.

Businesses and suppliers must work together in order to achieve processing time reduction by using available technologies (Huang, Cheng, Tsai & Wu 2007, p. 560). Order processing is also an area in the business that can be used to reduce costs and this will affect lot-size decisions and allow supply chains to move closer to JIT ordering, with single item flow (Huang et al. 2007, p. 560). Operations scheduling and inventory management are the two

critical aspects of a business that directly influence how the business effectively uses its assets and capacity when producing goods and services (Wisner, Tan & Leong, 2005, p. 157).

2.9 Warehouse management

Warehouse management is a critical part of supply chain management and it requires procedures that include software or manual systems for the necessary transactions within the warehouse (Atieh et al., 2016, p. 568). Companies that have automated warehouse systems are more efficient and reliable when compared to the warehouses that use manual systems (Atieh et al., 2016, p. 568). Warehouse management systems (WMS) are software systems that are used to control and monitor the warehouse activities such as receiving, shipping, real time products tracking, space optimization, scheduling, planning, forecasting and managing inventory (Jomaa, Monteiro, & Besombes, 2013, p. 178). According to these authors, it is crucial for companies to use WMS so that they are able to optimize their operations including inventory replenishment, as well as improving on the forecasting system that is being used.

In contrast to a WMS, which focuses on order management, a warehouse control system (WCS) manages and controls the facilities in the warehouse such as the material handling equipment (Son, Chang & Kim, 2015, p. 1345). These systems are designed to provide flexibility, reliability and information visibility, so they can be used to support the WMS by monitoring and controlling material flow (Son et al., 2015, p. 1345).

2.10 Warehousing and storage design

According to Kłodawski, Jacyna, Lewczuk & Wasiak (2017, p. 452), warehousing is the set of actions and activities that comprise the receiving, issuing, storage, picking and shipping of material where it is needed. The role of warehousing in the supply chain is to provide an effective flow of material from suppliers to distributors or end-users (Pyza, Jachimowski, Jacyna-Golda & Lewczuk, 2017, p. 706).

2.10.1 Warehouse site selection

The warehouse function is a critical area of the supply chain network since it assists the company to reduce costs and streamline the operations. Outsourcing this function allows the company to focus on their core business but introduces risks as a result of loss of control over materials (Wutthisirisart, Sir, & Noble, 2015, p. 780). The site selection and layout are equally important, with factors such as roads and proximity to suppliers affecting the placing

of warehouses while the layout must be adapted to the selected site (Song et al., 2017, p. 848).

García et al. (2014, p. 61) indicated that there are different techniques that can be used to select the ideal site location for a company's warehouses, taking into account the market being served, competitors and suppliers. The company needs to understand the different location strategies (market positioned, product positioned and intermediately positioned) so that they are able to locate closer to all resources that they will need (Wisner et al., 2014, p. 293). These three strategies are: to locate their warehouses nearer to customers to maximise distribution services and allow the company to save money on transportation if a number of customers must be supplied with goods; to locate their warehouses nearer to the sources of supply, whereby the company will be able to consolidate various materials before they are collected for customer's deliveries, or to locate their warehouses midway between the sources of supply and the customers. Selection techniques used to find the best location for warehouses include simulation, analytic hierarchy process and linear programming (García et al., 2014, p. 61).

2.10.2 Warehouse layout

The warehouse layout decisions are important since they affect the warehouse performance, such as material handling, material costs and storage capacity (Rakesh & Adil, 2015, p. 1155). Warehouses represent a capital investment (facility construction) and incur operational costs which must be minimised (Rakesh & Adil, 2015, p. 1156). Appropriate warehouse design will assist the company to improve its distribution systems since it will ensure that inventory can be accessed and moved efficiently (Pyza et al., 2017, p. 707). Storage space is used most efficiently when material is positioned in terms of its individual features such as vulnerability to breakage, length of storage time, suitability for manual or automated handling, and material volume and weight (Bowersox et al., 2010, p. 391; Pyza et al., 2017, p. 707). Furthermore, the storage area in the warehouse must be designed to allow the movement of material to a staging location, moving material for preparing orders and moving material to the shipping area (Bowersox et al., 2010, p. 390).

Warehouse design decisions may include height and width of shelving, aisle width and number of cross aisles. Material may be located at different levels, each of which is usually divided into spaces of the same dimensions (Matić, Kratica, Filipović, & Dugošija, 2012, p. 162).

The conventional layout design of a warehouse consists of parallel pick aisles and wider middle aisles (Çelik & Süral, 2012, p. 1). These authors investigated alternatives to the traditional layout which will allow the company to save space and increase the efficiency of gathering (picking) items to fulfil each individual order (Çelik & Süral, 2012, p. 2). They found that a fishbone layout design is beneficial in single-command operations since it reduces the walking distance between the aisles compared to the traditional middle aisles and optimises the use of space while minimising materials handling costs (Çelik & Süral, 2012, p. 3).

2.10.3 Material Handling

Material handling is defined as moving material from one point to another. It requires resources, both equipment and people (Green, Lee & Kozman, 2010, p. 2975). Efficient material handling requires precisely organised movement of materials in the exact quantities, and this must be done in the minimum possible time, with the required labour at the maximum safety without wastage of expenditure (Fellows, 2009, p. 1077). The material is handled well when the company successfully implements labelling and packaging standards and ensures that the concept of First In First Out (FIFO) and Last In First Out (LIFO) are implemented where appropriate (Atieh et al., 2016, p. 572). It is a good strategy for companies to automate material handling because it increases productivity and ensures accuracy (Choe, Tew & Tong, 2015, p. 891). Furthermore, advanced material handling systems can be developed using computer technology which not only automates machinery but also provides important information to support employees that work in the system, thereby increasing efficiency and reducing stress (Choe et al., 2015, p. 891).

2.11 Reverse logistics

Reverse logistics, also known as return processing, reverses the direction of product flow so that material is returned to the producer from the customer (Hugos, 2011, p. 94). This encompasses both returns for remanufacturing (recycling) and return of unwanted goods. Mangan and Lalwani (2016, p. 276) further explained that reverse logistics may include the return of end life material (as in the case of electronic goods which manufacturers are obliged to dispose of), return of defective, damaged and unwanted material, and the return of packaging or containers required for the transport of materials such as pallets and barrels. When goods are returned because the customer is not satisfied, the company must keep a

record of which products are returned, the number of returns and the reason for this. Rates of return should be monitored to see if they are increasing or decreasing (Hugos, 2011, p. 94).

In reverse logistics for disposal or recycling, the sequence of operations starts at the customer level with a request for the collection of the material that is to be re-processed or scrapped at the industrial facilities (Alshamsi & Diabat, 2015, p. 549). This aspect of logistics is often problematic and incompetently managed (Hugos, 2011, p. 94). Various techniques have been developed to improve this aspect of the supply chain, such as the mixed-integer linear program (MILP) approach recommended by Alshamsi and Diabat (2015, p. 549). These methods attempt to address the complex network structure of the reverse logistics system, which links customers back to manufacturers. While returns can add value when the material is recycled, the logistics management of this material and its preparation for remanufacturing can be challenging (Hugos, 2011, p. 94). The company must select a place where they will install reprocessing facilities, and when this decision is made it has a direct influence on the transport cost and the facility installation fixed costs (Coelho & Mateus, 2017, p. 1165). Lately reverse logistics has received substantial attention because of growing concern for sustainability, which requires that the environmental, economic and social impacts of goods be taken into account (Alshamsi & Diabat, 2015, p. 589)

2.12 Inventory problems

Businesses must manage inventory in order to reduce the costs associated with it (Zappone 2014, p. 1). As this author indicated, businesses need to close the gap between inventory theories or principles and practice. The business may fail if inventory processes and systems are not implemented as they should be.

Some common problems of inventory in supply chains are:

- Push scheduling in which materials are sent by providers regardless of whether they are needed. This results in a build-up of unneeded stock on the company's premises (Harrison et al., 2014, p. 185).
- Bulk purchasing may deliver cost savings per item but also causes build-up of inventory with all the implications for cost, space and obsolescence mentioned above (Christopher 2011, p. 230).

- Long lead times create problems, particularly if demand is variable. They increase the requirement for buffer stock and prevent organisations from operating an efficient pull strategy (Harrison et al., 2014, p. 210).
- Stock-outs occur when the material is not available when customers need it. This situation forces customers to search for different products as substitutes since their first choice material is not available. They may not come back if they like the substitute and find it more readily available (Li & Fu, 2017, p. 813). Furthermore, stock-outs may cause delays in finishing projects and these costs may be passed on to the supplying company if supply contracts have been established.
- Reverse logistics is a considerable challenge for many companies, especially the ones that receive a high volume of returned material. Returns must be organized into distinct categories in order to see if they can be reused or if they have been damaged or become obsolete (Patil & Divekar, 2014, p. 569).
- The “bull-whip effect” (BWE), by which small changes in demand are magnified backwards through the supply chain (Harrison et al., 2008, p. 183). Bullwhip is a serious problem in supply chains because the demand intensification generates excess inventory, which consumes warehouse capacity, ties up capital and has cost implications if that inventory is never used as it is scrapped or becomes obsolete. BWE occurs when misrepresentation occurs in the process of conveying order data upstream, resulting in a large variation in upstream order quantities that is caused by variation of downstream demands (Dai, Peng, & Li, 2017, p. 1229). The presence of a BWE causes uncertainty for decision-makers, generating higher costs and impaired inventory management efficiency. As a result the business ends up with excess inventory. Some causes of this effect have been postulated to include demand signalling, order batching, price fluctuations, rationing and shortage gaming (Lee, Padmanabhan & Whang, 2004), replenishment delay (Warburton, 2004), cognitive issues involving the decision makers (Sternan, 1989; Croson and Donohue, 2006), reliability (Taylor, 1999), forecast quality (Chen, Drezner, Ryan and Simchi-Levi, 2000) and measurement errors (Miragliotta, 2006).

2.13 Study Gap

The review discussed features of inventory systems that result in inefficiencies; it examined how demand, the supply chain, information, business goals and decision-making impact on the management of inventory. However, little has been written about the impact of decision-making and how communication affects the management of inventory. Also, there has been little research on internal control systems of managing inventory which are capable of giving early warning of stock imbalances and space control. With few qualitative studies that focus on excess and shortage of stock, and how decisions and actions lead to inventory problems this has created a gap in the body of knowledge. This gap is addressed by the current case study of the South African energy giant, with reference to the KwaZulu Natal Operating unit.

2.14 Conceptual framework

The conceptual framework represents the researcher's belief of which variables are relevant to the research problem and how they are related to each other (Sekaran & Bougie 2016, p. 82). The conceptual framework that was used in the study was based on the model of inventory management developed by Haines et al. (2010, p. 113) and shown in Figure 2.2. These authors described the effect of ordering inefficiencies on inventory levels and customer service. They incorporated the way in which managers make decisions based on perceptions into their model, as well as the effects of the context in which the supply chain is situated and the feedback from the outcomes of decision making processes. A summary of the model is discussed briefly below.

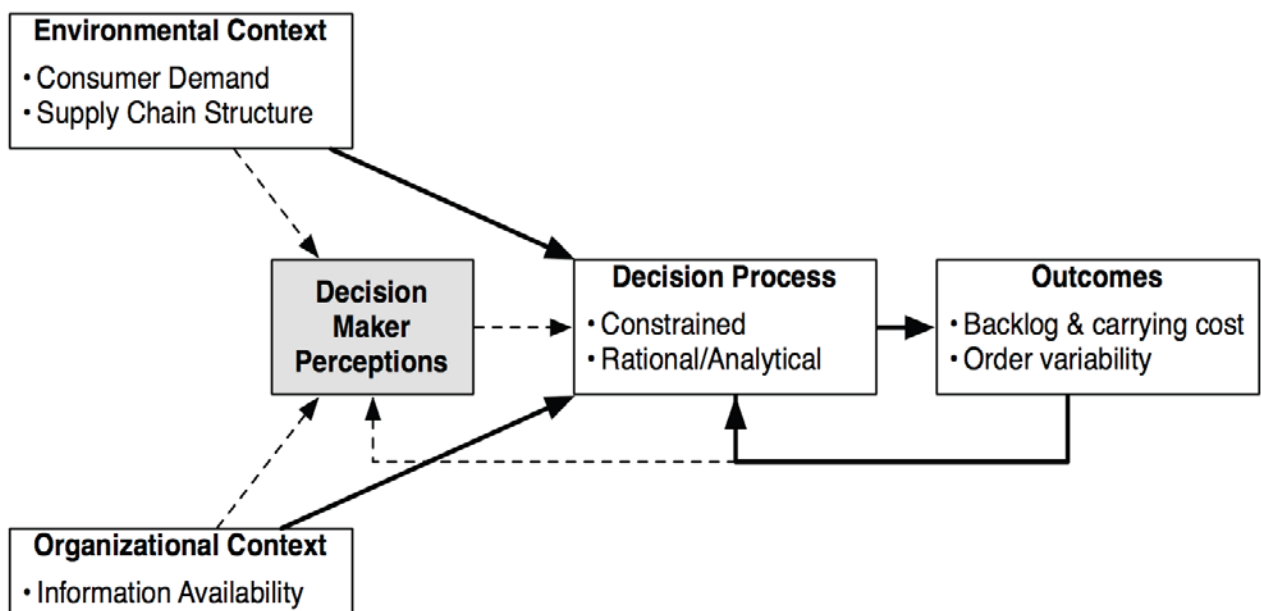


Figure 2.2: A theoretical model of supply chain decision-making (Source: Haines et al., 2010, p. 113)

Ordering inefficiencies have an effect on inventory levels and customer service within the supply chain. Therefore decision makers must understand the environmental context (consumer demand and supply chain structure) as well as the organisational context (information availability). This will assist them to make sound decisions that will have positive outcomes (Haines et al., 2010, p. 111). Moreover, the “bullwhip effect” is a major contributor to ordering inefficiencies (Haines et al., 2010, p. 111). Sterman (1989, p. 48) and Peter (1990, p. 52) indicated that the bullwhip effect is generated when managers do not take into account orders that they have created that don’t match with the supply. The starting point for improving inventory management is to have decision makers who will be able to make appropriate ordering decisions by considering information about the consumer demand as well as the information about orders that have not been delivered in the supply line (Haines et al., 2010, p. 112). Furthermore the members within the supply chain management structure must be provided with accurate information about the demand from customers so that they will be able to match those demands with supply (Haines et al., 2010, p. 112).

The theoretical model of supply chain decision making describes how decision makers make informed decisions considering the environmental context and organisational context in order to reduce the bullwhip effect so that the organisation can accurately measure market demands and balance them with the supply of inventory (Dai et al., 2017, p. 1229). The bullwhip effect is the misrepresentation that occurs as data is conveyed upstream. This results in the larger variations in order quantity further up the supply chain as a result of changes in demands downstream (Dai et al., 2017, p. 1229).

Effective supply chain management can reduce the bullwhip effect, improve response time within the supply chain and reduce the operating costs of the company (Dai et al., 2017, p. 1230). Understanding the influences on supply chain decision making is important within supply chain management because decision makers must optimise the supply chain operations with the smallest cost, for the purpose of improving supply chain from purchasing to satisfying the needs of the end-user as well as workflow, material flow and information flow (Dai et al., 2017, p. 1230).

The contextual influences on inventory management decisions which will be studied are depicted in Figure 2.3. Business goals, which incorporate the company’s vision and the

influence of senior management, were added as a further factor because the researcher's experience suggests that these are significant considerations in Eskom's material management decision making processes. Further to this model, it is hoped that the study will explain how the decisions made by managers result in the outcomes such as those described by Haines et al. (2010, p. 113), as well as any feedback effects which may occur. The model factors are described further in the sub-sections below.

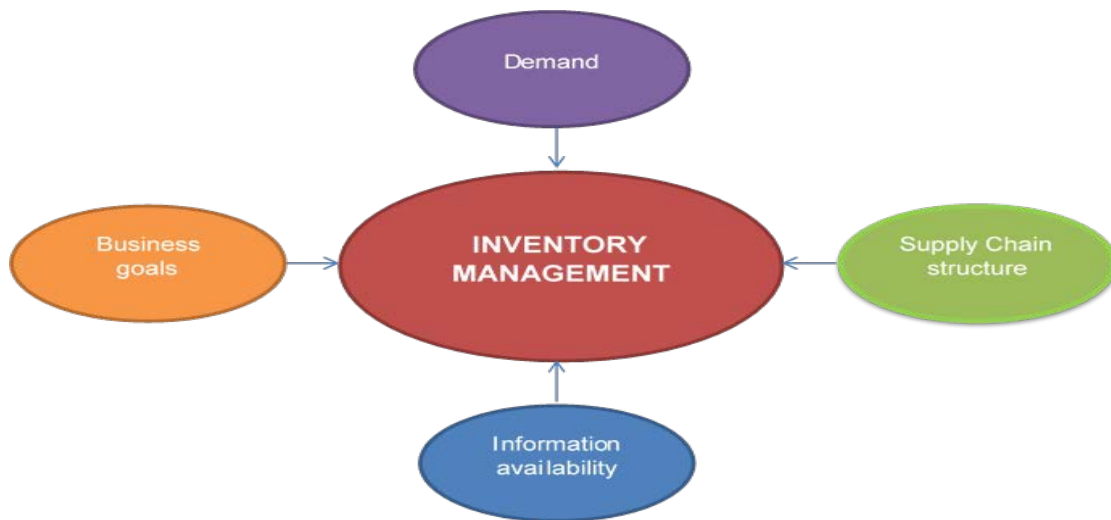


Figure 2.3: Conceptual model of inventory management decision-making (Source: Author's own construction)

2.14.1 Demand

The management of inventory with uncertain demand requires both strategic and tactical decisions (Neale & Willems 2009, p. 388). Strategically, managers must decide where to locate inventory and what level of service each warehouse will provide while tactically the level of inventory to be held at different times must be decided as demand changes on a weekly, monthly or seasonal basis (Neale and Willems 2009, p. 389). Additionally, it is important for companies to increase their awareness of demand by carrying out analysis and coordination among supply chain partners, thereby identifying the factors that stimulate the purchase of the product. By understanding the demand for their products, the company will be able to develop an advantage in a competitive market (Giri, Roy, & Maiti, 2017, p. 747).

Supply chain managers are challenged because they face increasing inventory management costs and changing demand patterns (Giri et al., 2017, p. 748).

2.14.2 Supply chain influences

For a business to remain competitive, it is important that it increases its product offerings and provides high levels of customization (Sreedevi & Saranga, 2017, p. 332). As is noted above in the theoretical model of supply chain decision-making, the decision makers have to consider the environmental context when supply chain decisions are to be made because businesses that are operating in high environmental uncertainty are faced with a high risk of supply disturbances, manufacturing and delivery delays and these eventually result in poor levels of delivery to the customer (Sreedevi & Saranga, 2017, p. 332). However, businesses can reduce supply chain risks with efficient supply chain design that improves the operational performance of the business (Sreedevi & Saranga, 2017, p. 333). Moreover, the supply chain must be designed to give supply chain employees a clear understanding of the influences on the business so that they can be more responsive to changes and know when to order and in what quantities. This is important because when the people that generate orders do not have a comprehensive understanding of the supply chain, they will be unable to apply analytical methods of to calculate the amount of inventory that is needed (Haines et al., 2010, p. 111).

Increasingly, firms are competing on the basis of their supply chains rather than their individual firm's strengths (Artsiomchyk & Zhivitskaya, 2015, p. 1695). Businesses that have effective supply chains that are difficult to imitate are likely to be successful. Such innovative supply chain strategies include the development of information management and associated technologies to create advanced logistic networks and flexible, responsive supply bases (Artsiomchyk & Zhivitskaya, 2015, p. 1695). Hence innovation is an essential supply chain characteristic as a constantly evolving business environment offers new ways of increasing customer responsiveness through social media, managing replenishment more efficiently through improved communication with suppliers, automated ordering using point of sale data and numerous other opportunities for the application of technology to enhance efficiency (Artsiomchyk & Zhivitskaya, 2015, p. 1696).

2.14.3 Information availability

Although advances in technology offer businesses new methods of obtaining and utilising information in their planning, the coordination of information sharing within supply chain is required so that the pertinent customer demand data is made available to upstream supply

chain stakeholders (Ali, Babai, Boylan, & Syntetos, 2017, p. 984). This requires a willingness on the part of all stakeholders to share information that may previously have been guarded within each company in the chain. The availability of information is crucial but a range of factors may affect the collaboration between members of a supply chain, such as enabling technology and goal congruence (Hudnurkar, Jakhar, and Rathod, 2014, p. 193).

Businesses require information about their customers so that they are able to provide the goods and services that are required at the right time, with good quality and in the correct quantities. Furthermore, this transfer of information will assist in reducing uncertainty in future demand (Ali et al., 2017, p. 984). When information is shared efficiently, forecasting procedures will lead to accurate estimates of supply chain inventory requirements (Hayya, Kim, Disney, Harrison & Chatfield, 2006, p. 1313). Additionally, business needs to collaborate with the stakeholders in its supply chain in order to ensure that service levels are maintained and that the bullwhip effect is avoided (Boylan and Syntetos, 2010, p. 232). According to Kembro, Näslund, and Olhager (2017, p. 81) the outcome of information sharing in the supply chain depends on three factors: the ability to forecast, competence in planning and information quality. It is important for businesses to share information in order to prevent late information, misunderstood information and difficulty in collecting information. When the information is late it becomes a challenge to upstream members since decisions are made on old information and that results in distortion of demand (Kembro et al., 2017, p. 81).

2.14.4 Business goals

Contemporary businesses are challenged with many changes to the business environment and increasing complexity of global markets, and it is important for business leaders to develop clear and achievable goals and expectations within their businesses (Aparicio, Basco, Iturrealde, & Maseda, 2017, p. 157). Ruiz, Costal, España, Franch, & Pastor (2015, p. 331) described two different approaches to understanding the relationship between business goals and business processes: integration and non-integration approaches (Ruiz et al., 2015, p. 331). The integration approach is concerned with the motivation processes that drive businesses and individuals to achieve the goals, whereas the non-integration approach is about goals that may be used to direct the process design (Ruiz et al., 2015, p. 331). Furthermore the integration approach may assist businesses requiring change management,

because it identifies dependencies between functions and can also assist in identifying the goals that stimulate change as well understanding their influence on the process (Ruiz et al., 2015, p. 332).

The main purpose of businesses is to serve and fulfil the needs of customers efficiently and to make profits (Che-Ha, Mavondo, & Mohd-Said, 2014, p. 2811). Moreover the goals of the businesses must be aligned with the desires of the businesses' shareholders and other stakeholders and this can be achieved by understanding the complete business orientation (Che-Ha et al., 2014, p. 2812). It is essential that the leaders of the businesses communicate the goals to all employees and ensure that they are motivated to achieve them, and that they have all the required resources to achieve them (Che-Ha et al., 2014, p. 2813).

2.15 Conclusion

The review of the literature in this chapter provides the background to the research questions set out in Section 1.6 and the research objectives described in Section 1.7. The literature centred on inventory management and highlighted how organisations need to develop pragmatic policies to optimise flow in the supply chain in order to achieve excellent performance. A conceptual framework was developed from the literature to guide this study. The study seeks to investigate the features of the inventory management system in the Eskom KwaZulu-Natal cluster and attempts to identify the decisions and actions that lead to inventory problems. The research methodology employed in the study is described in the following chapter.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

In Chapter two, existing literature on the subject of inventory management was critically reviewed in order to assess and contribute to the body of knowledge on this subject. This chapter presents the research methodology adopted to investigate the inventory management in the electricity industry in South Africa, using Eskom KwaZulu-Natal as a case study.

3.2 Research objectives

The aim of this study is:

- To investigate the features of Eskom's inventory system.
- To ascertain how Eskom integrates demand from its project teams into the management of inventory.
- To determine how Eskom's supply chain structure influences its inventory management.
- To understand how information availability affects Eskom's management of inventory.
- To determine whether Eskom's business goals affect decision-making in materials management.
- To provide recommendations for improvements to the decision making processes affecting inventory management at Eskom.

3.3 Study site

This research study was carried out in the material management department in KwaZulu-Natal (New Germany, Howick, Colenso and Marburg) procurement and the electrification/project department of Eskom. These sites were selected because they are where the warehouses, within cluster five (KwaZulu Natal Operating unit) are located. The selected departments are Materials management, Procurement and Projects/ Electrification. This selection was done in accordance with the value chain, that is, the flow of activities in sourcing, storing and distributing materials within the system of Eskom.

3.4 Research approach

There are two alternative research approaches, namely qualitative or quantitative (Kalof, Dan, and Dietz, 2008, p. 34). The combination of both gives rise to what is known as mixed methods research (Creswell, 2013, p. 3). The choice of research approach is based on the type of phenomenon being investigated and the nature of the data for the intended study (Creswell, 2013, p. 3).

A quantitative approach is based on the use of numerical or statistical data. Qualitative research does not primarily apply numerical data (Babbie, 2013, p. 24; Creswell, Plano-Clark, Gutmann & Hanson, 2003, p. 209; Kalof et al., 2008, pp. 14-15; King, Keohane, & Verba, 1994, p. 4). A quantitative research approach is therefore an objective method of investigating theories via the exploration of the relationship between measurable variables (Creswell, 2013, p. 4).

Qualitative research investigates the meaning an individual or group of individuals attach to a given phenomenon. The process of qualitative research is usually interactive, using interviews to collect data within the participant's normal situation. According to Tewksbury, (2009, p. 50), "qualitative research seeks to provide in-depth, detailed information which, although not necessarily widely generalizable, explores issues and their context, clarifying what, how, when, where and by and among whom behaviours and processes operate while describing in explicit detail the contours and dynamics of people, places, actions and interactions." Creswell (2013, p. 4) states that "often the distinction between qualitative research and quantitative research is framed in terms of using words (qualitative) rather than numbers (quantitative), or using closed-ended questions (quantitative hypotheses) rather than open-ended questions (qualitative interview questions)."

The research approach that will be adopted in this study is qualitative since the nature of the study makes it appropriate to investigate issues in their business context (Edmonds & Kennedy, 2017, p. 142). Therefore, the researcher decided to adopt qualitative research because the study is exploratory case and the nature of the study needed information from individuals in order to understand the problem in its context, and the causes of inventory complications at Eskom in KwaZulu Natal Operating Unit.

3.5 Research paradigm

A research paradigm is a particular mind-set regarding what should be investigated and how the research should be carried out (Bertram & Christiansen, 2014, p. 22). This study uses an interpretivist research paradigm. According to Reeves and Hedberg (2003, p. 32), an interpretivist paradigm emphasises analysis within a setting in order to understand the situation as it is from subjective experiences of the people in the context. The paradigm is meaning-oriented rather than a measurement-oriented worldview. It uses interviews, with interaction between the researcher and participants. It focuses on human reasoning and aims at giving explanation to their subjective underlying reasons and the meanings behind their social action rather than pre-empting the variables (Kaplan & Maxwell, 1994, p. 55). The reason for adopting this paradigm is that it helps to understand the phenomenon in context by getting information from the relevant people.

3.6 Research design

The research design is the “plan for the collection, measurement and analysis of data, created to answer your research questions” (Sekaran & Bougie, 2016, p. 95). Eriksson and Kovalainen (2015, p. 28) also stated that research design is a plan that indicates the methods for the collection, analysis and interpretation of data. According to McMillan and Schumacher (2014, p. 166), the research design is a framework that guides the selection of the study sites, the participants, and the data collection processes. Durrheim (2006, p. 34) described it as a plan of action that links the research questions and the research processes.

The research design of this study will be case study. This approach “allows in-depth, multi-faceted explorations of complex issues in their real-life settings” (Crowe et al. 2011, p. 102). However, there are different types of case studies that are presented by Fraenkel, Wallen and Hyun (2011, p. 435):

- An intrinsic case study which entails the study of a single, specific individual or situation most often in an exploratory study that seeks to have an in-depth understanding of a little known phenomenon
- An instrumental case study in which the researcher seeks to learn more than the particular case in order to gain broader understanding and to draw conclusions that are not narrowed to the case being studied.

- A multiple-case study in which more than one cases are studied as part of the same research project.

This study will adopt the intrinsic case study research design, since it is exploratory and the researcher knows little about the phenomenon. This will facilitate the discovery of patterns and relationships affecting the management of inventory at Eskom in KwaZulu-Natal. This exploratory research design will be used to develop a better understanding of the problems in managing the inventory in the electricity industry (Hair, Celsi, Money, Samouel & Page, 2015, p. 155). This is considered appropriate since the context conditions are considered important and different from those pertaining to studies carried out in other parts of the world (Yin, 2014, p. 16). The research does not seek to generalise beyond the specific case but to find solutions for context-specific problems. This revelatory case may lay the groundwork for theory building as is suggested by the inductive approach but is not expected to produce definitive theory (Bryman & Bell, 2015, p. 62).

3.7 Research population

Sekaran and Bougie (2016, p. 236) defined a population as the “entire group of people, events or things of interest that the researcher wishes to investigate”. Moreover the population is the collection of units or people in a given area, at a given time, where a study will be conducted (Sekaran & Bougie, 2016, p. 240). In this case study, the unit of analysis is the company which is being studied (Eskom, KwaZulu-Natal) (Yin, 2014, p. 31). Within the case study, the population selection was done among the staff of Eskom that is in junior, middle and senior management from procurement, material management and electrification/ project management departments in KwaZulu-Natal.

3.8 Sampling

The sample is the subset of the whole population that is investigated by the researcher (Sekaran and Bougie, 2016, p. 237). The features that are identified from the study may allow the researcher to generalise to the entire population of interest. Because the case study method was used, the findings are not generalizable beyond the company under consideration, but the sample of the population of staff within the company must allow the findings to be extended to the whole unit. Patton and Cochran (2002, p. 10) argued that the samples used in qualitative studies are generally purposive. In this type of sample,

participants are chosen for their knowledge of the particular data which is needed to achieve the research objectives.

3.8.1 Sampling method

The sampling method is the way in which the researcher chooses the right elements from the population in sufficient numbers to allow him or her to study their properties. The sample must be chosen so that such properties can be generalised from the sample to the population (Sekaran & Bougie, 2016, p. 239). In this study the researcher used a non-probability sampling method together with purposive sampling. All members of the population did not have an equal chance of being selected since the participants were selected based on the judgement of the researcher. The researcher selected people from a specific target group that was able to provide the information that was needed to gain insight into the phenomenon under investigation.

3.8.2 Sample size

Patton and Cochran (2002, p. 10) noted that sample sizes are generally small in qualitative research. To ensure that the sample is large enough, the researcher can continue to interview people until no new information is provided. In deciding on the sample size for the study, the researcher had to ensure that the sample was large enough and selected so that the findings could be generalised but also that the sample was not too big to make the analysis of data too difficult.

In this study it was decided that a point of fullness could be reached if at least 10 employees (20% the population) were successfully interviewed in the form of in-depth interviews. However, the researcher decided to plan to interview 15 people in case some were unable to participate. In order to ensure that all sections of the material management department were represented, the researcher interacted formally with warehousing, planning, procurement and project management employees who are knowledgeable in terms of operations and activities within material management. The sample is classified below:

- 8 employees from material management department,
- 3 employees from procurement department,
- 4 employees from electrification department.

However, only thirteen of the targeted fifteen participated. In order to assess as many of the 6 warehouse locations as possible, the 8 material management employees were divided as follows:

- Empangeni regional distribution centre (1),
- New Germany regional distribution centre (4),
- Marburg regional distribution centre (1),
- Colenso regional distribution centre (1),
- Howick regional distribution centre (1).

3.9 Data collection

Initial data was collected by studying documents that describe the business activities of Eskom and focus on inventory management. The sources included information that is publicly available on the internet, a few academic papers written on the subject and policies available to the researcher as an employee of Eskom (with the permission of her employer). Therefore, the researcher was able to investigate the materials management system through her role as a materials manager. This information also served to triangulate data provided by the study participants about the decision-making processes at Eskom and their effect on inventory management.

This study used interviews (See Appendix E) for collecting primary data because the target participants were the main source of the information that was required, since they are directly involved in inventory management and decision-making. The interviews were electronically recorded and notes were taken as a backup. The interviews were collected from five different locations namely: Howick one person on the 30th of October 2017; Empangeni one person on the 3rd of November 2017; New Germany five people on the 7th of November 2017; Colenso one person on the 8th of November 2017; and Marburg one person on the 9th of November 2017. The three participants from Westville were interviewed on the 13th of November 2017 telephonically; this is because they are field workers, hence difficult to get an appointment with. Apart from the MM1 interview that took about forty minutes, the rest of the interviews were approximately 30 minutes each.

3.10 Data analysis

Data analysis is a process of reviewing and interpreting the results that have been collected with the aim of determining useful information (Sekaran & Bougie, 2016, p. 332). The data that was collected from documents was summarised through content analysis (Sekaran & Bougie, 2016, p. 350). This followed a conventional, qualitative content analysis approach: while codes were developed to assist in allocating ideas to different themes, these were not counted as they would be in quantitative content analysis.

Once transcripts of the recorded data from interviews were made, the researcher used content analysis to identify ideas in the data that represent the phenomenon being investigated. The researcher used the conceptual framework to help with the clarification of themes but also looked for new themes in the participants' contributions. This is consistent with the inductive approach (Sekaran & Bougie, 2016, p. 336).

3.11 Reliability and validity

Reliability in case studies is particularly concerned with whether the categories or themes used would be those chosen by other judges, and whether the observations or participant comments are allocated appropriately to those themes (Sekaran & Bougie, 2016, p. 348). The conceptual framework and the literature studied were used to strengthen the reliability of this process in this study. The researcher also triangulated data from different sources (observation, interviews, documentation) to improve reliability (Barratt, Choi & Li, 2011, p. 331).

Validity is “the extent to which an instrument measures what it purports to measure” (Sekaran & Bougie, 2016, p. 349). Internal validity, or the accuracy with which the results represent the data, is improved by the participation of the researcher in the study context, with a resulting congruence between concepts and understanding (Bryman & Bell, 2015, p. 395). In this study, the researcher was working in the material management department and was able to make observations and link these to the theory that was available, thereby developing a valid set of themes to guide the content analysis. Due to the nature of the in-depth interviews, the researcher was able to explain the questions if necessary in order to ensure that had a consistent understanding so that validity was maintained. External validity was considered less important, since the aim was not to generalise the findings of the study to a wider population at this stage.

3.12 Interview guide

A pilot test of the research questions was conducted using 10 post graduate students in management at the University of KwaZulu-Natal. The six questions proposed for the investigation were deemed fit for the research, hence were used without alteration. The ten post-graduate students selected for the pilot test unanimously affirmed that the questions were easily understandable and that they addressed the research objectives without ambiguity.

3.13 Ethical considerations

The ethical approval (See Appendix C) for this study was obtained from the University of KwaZulu-Natal Ethics Committee, to confirm that human dignity will be protected in such a way that the rights and freedom for people that participated will not be compromised. As a vital part of ethical requirements, a gatekeeper permission (See Appendix D) to conduct the research at Eskom was duly sought and obtained. The researcher also provided an informed consent letter (See Appendix B) to the participants in order to provide adequate information regarding the study so that they were able to make an informed decision to participate. Finally, the researcher has ensured that the privacy and confidentiality for participants is maintained by the use of codes instead of their names when the information is being shared.

3.14 Conclusion

Chapter three has meticulously unpacked the research methodology adopted for case study. It explained the interpretivist research paradigm as the fundamental perspective of the researcher. It clarified and justified the choice of the qualitative research approach adopted, and the research design that guides the selection of the study sites, the participants, and the data collection processes. The chapter also discussed the modality used to ensure reliability, validity of data, and the ethical compliance. Chapter four discusses the purchasing procedures at Eskom, the logistics management and the policies that control inventory, and explains their functions.

CHAPTER 4: INVENTORY MANAGEMENT AT ESKOM

4.1 Introduction

The Council of Supply Chain Management Professionals defined logistics as the “process of planning, implementing and controlling procedures for the efficient and effective transportation and storage of goods including services, and related information from the point of origin to the point of consumption for the purpose of conforming to customer requirements” (Choi, Chiu, & Chan, 2016, p. 1). This supply chain function includes both inbound and outbound logistics, for which transportation and inventory control must be properly managed. Logistics systems are required that can manage these critical functional areas in an increasingly globalised business environment (Choi et al., 2016, p. 1).

Supply chain planning is the functional team that incorporates the requirements for demand planning and supply planning in order to assimilate and synchronise the demand and supply components within the supply chain (Eskom, 2014, p. 121). The supply chain operations group (SCOPS) is another function that exists at Eskom within the Group Technology and Commercial division and which is responsible for operational management of the warehouses and the control of inventory (Eskom, 2014, p. 121). Supply chain planning and supply chain operations work together because the planning team arranges the material that is needed based on the demand and supply and then communicates with the warehousing team to expect deliveries when the order is ready for delivery. Currently these two functions are grouped together and are referred to as the materials management unit.

This chapter will describe the purchasing procedures at Eskom, the logistics management and the policies that are in place to control inventory management. It will explain the way these functions are designed to operate. This will be done by starting with an overview of Eskom, and then moving to the demand planning, procurement, logistics management, inventory management, warehouse management, location, and layouts, material handling and reverse logistics within Eskom.

4.2 Company overview

The organisational structure of Eskom is in the process of being revised to include new appointments, since the company has had recent changes to the executive. Nevertheless, below is the diagram that illustrates the organisational structure as it has functioned over the last few years.

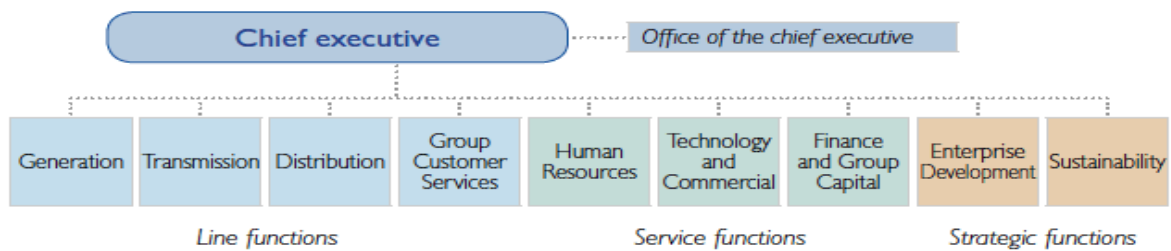


Figure 4.1: Eskom organisational structure, 2014

Eskom is the state-owned electricity supplier in South Africa, providing generation, transmission and distribution, as well as importing and exporting of electricity. Eskom supplies industrial, mining, commercial, agricultural and residential customers in South Africa; the company also supplies entities such as municipalities and metros and they redistribute that electricity to businesses and households in their areas. Eskom recognises that the private sector can contribute towards electricity generation and hence they purchase electricity from local independent power producers (IPPs). The IPPs are engaged in the production of renewable energy which is fed into the national grid that is owned by Eskom. The electricity market is regulated by the National Energy Regulator of South Africa (NERSA) in terms of National Energy Regulatory Act and it issues licences and regulates requests from Eskom for tariff increases. IPPs are assisting the company to meet the rising demand for power and to ensure that the company is able to maintain a continuous supply.

Material management is a unit of the Group Technology and Commercial service function. This unit is responsible for logistics and inventory management. It is perceived as a supporting unit since it is responsible for getting the right suppliers that will be able to supply goods and services that are needed by the line and strategic functions.

4.3 Supply chain management

Eskom's procurement and supply chain management policy governs all supply chain management activities within Eskom Holdings SOC Limited (Eskom, 2014B, p.3). In the

policy it is indicated that the Group Technology and Commercial within Eskom must aim to operate in line with the company's strategic objectives as well as benchmarking itself with international practices (Eskom, 2014B, p.3). To achieve this, the group must provide procurement and supply chain management services across Eskom with standardised processes and procedures in order to satisfy the needs of customers and reduce operational risk within the company (Eskom, 2014B, p.3). The Group Technology and Commercial has developed process control manuals and procedures that are used to manage and control core procurement and supply chain functions for the sourcing of raw materials for electricity generation as well as for distribution projects. This group must also contribute to socio-economic development by training suppliers and buying locally as far as possible. This division includes materials management, logistics and supply chain planning (Eskom, 2014B, p.3).

Eskom uses the SAP internet-enabled system across its operational frameworks, and inventory is also managed by SAP system (Eskom, 2014B, p.3). SAP stands for Systems Applications and Products in Data Processing. It is the name of an ERP (Enterprise Resource Planning) software company, which provides database management and real-time processing which help companies to respond to situations in the supply chain that would not have been possible without ERP software (Rashid, Hossain & Patrick, 2002, p. 13).

4.4 Demand planning

In order to maintain and extend the supply of electricity, Eskom must generate an accurate forecast of the required materials for all its divisions before they can be ordered and delivered to its warehouses (Eskom, 2014B; South African National Treasury, 2017). This process is regulated by Section 3 of the Preferential Procurement Policy Framework (Act 5 of 2000) regulations and other legislation which governs Eskom as a state owned enterprise (Eskom, 2014B). This process is a combination of planning, forecasting, and estimation that is done by the Supply Chain Operations (SCOPS) in consultation with the end-users, (the relevant specialists such as the cost engineers, quantity surveyors). All materials should be ordered according to the provisions in the forecast.

In Eskom, the demand for commodities is derived from maintaining the infrastructure or plant, maintaining security of supply, and the demand for new installations to extend the

existing infrastructure (Eskom, 2014B). The varied nature of these activities results in two different models that are used to establish the demand at Eskom:

- **Anticipated Model**

This is the forecasting process that is used to determine the requirements for maintenance. Statistical techniques are used to predict future demand, based on historical demand (Eskom, 2014A).

- **Responsive Model**

This model refers to a qualitative approach whereby project managers use designs to develop bills of materials. Cross-functional teams are then involved in planning the supply requirements for the projects. Demand from all projects is aggregated to allow comparison with business objectives (Eskom, 2014A).

Engineers, quality managers, materials requirement planners, procurement managers and field maintenance staff are all involved in reviewing operational forecasts. At a strategic level, Group Technology and Commercial representatives from sourcing, supplier development & localisation (SD&L), supply chain planning, project management and finance are involved in the forecasting process. Data gathered includes manufacturing capacity of suppliers, expected lead times, supplier track records and regulatory requirements (Eskom, 2014A).

4.5 Procurement

Procurement is a process by which organisations acquire goods and services. Eskom manages its suppliers through the Eskom Supplier Database (ESD) which informs the organisation about the geographical distribution of suppliers and the logistical demands or constraints for any supply of goods or services. The supplier evaluation manager within SD&L conducts regular assessments on supplier registration processes executed to ensure that the details of suppliers registered on the Eskom supplier database are accurate, updated and adequate for use at any given time. Procurement practitioners, contract managers, and nominated SD&L officials liaise and engage with suppliers on an on-going basis via a number of accepted communication mechanisms that may include a dedicated e-mail address for suppliers to communicate with Eskom, surveys, and supplier forums.

At Eskom, end-users (project staff) or material management (warehouse staff) start the process of procurement. In the warehouse, SAP is used to generate a purchase requisition

(PR). The operational staff member is responsible for providing the procurement staff with the necessary specifications for the purchase and the estimated value of goods or services that are required. The manager responsible for the cost centre must approve the PR before it can be actioned by purchasing. The end-user must allow sufficient time for the procurement process to be properly implemented.

4.5.1 Vendor evaluation

The procurement practitioner, together with the end-user or cross-functional team does a formal cost-benefit analysis to establish whether it is more cost-effective to continue with the established supplier, or whether to request competitive tenders or proposals. This forms part of the motivation for the use of the supplier as a sole source. If negotiation only with the established supplier is envisaged, the negotiations are based on the best estimate of the cost of the work or services excluding site establishment costs. A properly motivated request for a mandate to negotiate must be presented to the delegated approval authority.

The procurement department is responsible for market analysis and for identifying suitable suppliers. They must ascertain what current prices and contracting practices are in the target industry so that there is adequate preparation for negotiations with suppliers. Calls for expression of interest (EOI) and requests for information (RFI) may be used to determine supplier interest, capability and capacity in the category of supply/services. Market analysis also allows procurement to determine if competitive tender or negotiations with only one or two suppliers is appropriate for the proposed purchase.

4.5.2 Competitive tender

Competitive tenders are advertised in Eskom's Tender Bulletin and/or in newspapers, on the radio or television or on the internet. The medium used depends on the goods being sourced and the nature of potential suppliers as well as the amount of money that it is justified to spend on this aspect of the purchase. All communication with the supplier about a specific tender during the evaluation process is in writing and co-ordinated only through the designated procurement practitioner managing the tender. Once approval has been given to the award of the contract, the successful supplier is notified and a contract is formed between Eskom and the supplier.

4.5.3 Sole source suppliers

A cross-functional team led by the procurement practitioner developing the commercial strategy may arrive at the conclusion or deduction that a sole source supplier situation exists. The strategy indicating a sole source supplier situation is compiled on the commercial strategy approval template and approved by the line manager of the procurement practitioner or the relevant delegated approval authority, based on stipulated strategy delegations. Where the sole source is an original equipment manufacturer (OEM) or a sole distributor of the OEM, who provides spare parts to Eskom, the cross-functional team determines whether to proceed directly to negotiations or whether to follow an inquiry process. It is not permissible to request a quotation or proposal from a sole source supplier without first presenting the mandate request to the delegated approval authority (DAA), as Eskom employees (including procurement practitioners) are not permitted to engage with suppliers in negotiations without a formal mandate.

After approval of the commercial strategy, the procurement practitioner, together with the cross-functional team, completes a commercial transaction approval form requesting a mandate to negotiate from the DAA. The approval of the commercial strategy and the request for a mandate to negotiate may be handled together by the DAA. A formal supporting motivation for use of the supplier as a sole source is provided by the end-user and approved by his/her designated executive-band manager, who is responsible for the technical and operational integrity of the assets, goods or services required. This motivation is set out within a sole source justification form which is duly signed and validated by all required signatories. Prior research into the prices needs to be conducted by the cross-functional team in order to determine a real and aspiration base for negotiations on price, and any other parameters which may become a negotiation objective, forming part of the mandate request. The procurement practitioner and end-user, together with any other members of the cross-functional team present the sole source justification form and the commercial transaction approval form to the relevant DAA for approval.

4.5.4 Two independent suppliers

In certain situations, where thorough market research establishes that there are only two capable and independent suppliers available to supply the assets, goods or services, thereby preventing use of a competitive tender (where a minimum of three independent suppliers are required) it is permissible to request a mandate to negotiate with both suppliers, without prior tendering. The inquiry and negotiation process is the same as that for a sole source supplier,

without the need for a sole source justification form. However, all offers/quotations greater than R5 million must be formally received by the relevant tender office.

4.5.5 Negotiation procedures

Once the mandate is approved, the procurement practitioner either proceeds directly with negotiations or prepares a request for a quotation or proposal, based on the approved mandate and in consultation with the cross-functional team, and then issues the inquiry to the supplier(s) for a quote or proposal. The offer or quotation is requested and submitted in the same way as for an informal tender up to R5m, and processed in the same way as a formal tender if greater than R5m. The cross-functional team then develops and plans their strategy for negotiation based on the supplier's proposal or quotation. In order to proceed with negotiations, the procurement practitioner arranges a venue, invites the relevant supplier and the negotiation team as per the approved mandate, formulates an agenda and ensures that minutes of the negotiations are recorded in writing. The lead negotiator, as assigned by the DAA granting the mandate, leads the negotiations and ensures that all mandated parameters are discussed and agreed upon. After each session of negotiations, the supplier and Eskom sign off the recorded minutes, as proof of what has been agreed to and what remains outstanding for resolution.

If the outcome of the negotiations is within the ambit of the approved mandate parameters, the procurement practitioner submits feedback of negotiations against the relevant section of the commercial transaction approval Form to the DAA, outlining the results of the negotiations against the mandated parameters. If the outcome of negotiations is outside the mandated parameters, the procurement practitioner, in consultation with the negotiation team or cross-functional team may request an approval of a negotiated outcome, a revised mandate or may request cancellation of the transaction from the DAA. Where the DAA grants approval to proceed with contract finalisation, the procurement practitioner in consultation with the cross-functional team prepares the contract documents and arranges for the signing thereof. The procurement practitioner ensures that all relevant documents are filed for audit purposes.

4.5.6 Renegotiation of purchase orders

It is permissible to enter into negotiations with a supplier, without a receipt of a mandate to negotiate, where a previous (once-off or stand-alone) purchase order was placed with such a supplier, provided that the purchase order was placed with such a supplier within the last six months. Another purchase order may be placed on this basis, subject to the previous purchase order being based on a formal or informal competitive tender, if there is evidence of the

market being properly tested, if the supplier has agreed to supply the assets, goods or services at a price less than or equal to that of the previous order and if the placement of the new order is authorised by a DAA. This mechanism applies only to stand-alone/once-off purchase orders and does not apply to contracts. This 6-month rule cannot be applied more than twice after placement of the original purchase orders.

4.5.7 Order processing

Order processing refers to a combination of activities that constitute how an organisation coordinates the requisition for its operational materials. If there is a contract in place, orders can be released from this to meet demand even if this is for unplanned requirements. If there is an emergency the end-user must obtain authorisation from a senior manager before contacting a procurement practitioner who then communicates the requirement to the supplier telephonically or via fax or e-mail. The request for quotation (RFQ) functionality in the electronic system may be used to send through RFQs electronically. The procurement practitioner instructs the supplier on how to go about submitting the quotation through to Eskom and arranges the delivery. The supplier faxes or e-mails a quote through to Eskom based on the instructions received in the RFQ. In the case of a telephonic inquiry, the procurement practitioner records the details like the price of the assets, goods or services and the delivery costs, and then requests a written response at a designated fax machine or e-mail address from the supplier as confirmation of what was communicated telephonically.

4.6 Logistics management

Goods imported by Eskom are usually transported by ship or air, while rail, and road are used for local purchases. Rail transport increases the chance of damage and takes longer time. Containerisation can reduce the risk of damage. Road freight services are faster but may be more expensive.

Rotek Logistics, as a subsidiary company under Eskom, manages all logistics requirements on behalf of the electricity company. Therefore, Rotek is tasked with the responsibility of transporting material from suppliers to the RDCs or project sites. Suppliers receive orders from procurement, and then acknowledge them. When the material is ready a notification is sent to Rotek for collection and the trucks are dispatched to collect material and deliver to the relevant RDC or sites. The outbound logistics entails the transporting and distribution of goods from the regional distribution centres (RDC) to maintenance teams or project sites. The

outbound logistics process begins with a request from an end-user, which is transferred to warehouse picking and packing then ends with material delivery.

4.7 Inventory management

According to the Eskom Material Guide (Eskom, 2013, p. 10) the main role of material management is to decide when material should be reordered, and in what quantities, in order to match the supply with the demand. This means that the material management must ensure that materials are available at all times to satisfy the requirements of the users. This can be done by identifying inventory that needs to reorder by monitoring stock levels, using appropriate reordering rules, and sending through requests to the buyers in good time. This department must also minimise the investment in inventory and ensure efficient warehouse management to minimise operating costs.

4.7.1 Inventory policy

The management of inventory commences with the categorisation of inventory items to ensure that fast-moving items are reordered timeously while slow-moving items or redundant ones are also managed appropriately (Eskom, 2014A, p. 121). Demand forecasting is seen as particularly effective where it is applied to selected commodities that are required by several divisions of the company and where items are used repeatedly or with a predictable demand pattern, such as transformers. The company seeks to minimise the investment in inventory, turn over stock as often as possible and ensure that required items are obtainable when needed.

4.7.2 Inventory systems

According to the Eskom procurement procedure (Eskom, 2014A, p.122) there are different systems that are used to manage inventory which includes an inventory Pareto classification and inventory categorisation. The inventory Pareto classification system is used to manage investment in inventory, by managing different classes of inventory according to their monetary value and rate of usage. The classification is used in the SAP system and follows the ABC division:

- A material consumes 80% of the annual expenditure.
- B materials consume 15% of the annual expenditure
- C materials consume 5% of the annual expenditure.

- D materials are those that are not moving and need to be disposed of.

The ABC classification is updated twice in the year.

The other system that can be used in managing the inventory is categorisation aligned to the different business segments as per the categories below (Eskom, 2013, p. 123):

- Project stock.
- Maintenance stock.
- Breakdown stock.
- Critical spares.
- Strategic spares, and
- Capital spares.

4.8 Warehouse management

Warehouse management is facilitated at Eskom by the use of the SAP system. All stock kept in the warehouse should be recorded on the system and these records change as stock is issued or orders are delivered to the warehouse.

The materials manager is responsible for warehouses in the business unit. However, that manager may delegate the accountability for the operations and management of warehouses to the appropriate qualified and experienced subordinate (Eskom, 2013, p. 127). At project sites there is a project manager who is responsible for the site stores and maintenance site stores such as Customer Network Centres (CNC's), have supervisors that manage all materials that are allocated to their sites. Policies and procedures are developed within the Group Technology and Commercial division.

4.9 Warehouse location

Eskom in KwaZulu-Natal has 6 warehouses and they have been strategically located close to its customers (end-users) so that they are easily accessible when material is needed. The first warehouse is known as Howick Regional Distribution Centre (RDC) located in Merrivale which is 10 kilometres away from Howick. This RDC provides service to the Pietermaritzburg and Ixopo areas. The second one is the Empangeni RDC, which services the surrounding area. The third one is the New Germany warehouse, located 15 kilometres from Pinetown. This RDC provides a service for the Durban area. The fourth one is Marburg RDC,

located 12 kilometres away from Port Shepstone city and providing a service to the Kokstad and Port Shepstone areas. The fifth one is Vryheid RDC, which provides a service to the Vryheid and Newcastle areas. The last one is the Colenso RDC, providing a service the Ladysmith area.

4.10 Warehouse layout

Previously warehouses or stores were not given any priority by Eskom and they were not prepared to spend money on any improvements. However, the old approach has changed drastically because the company realised that it is spending significant money on inventory and there was a need to develop and maintain its stores or warehouses. Eskom owns and runs its warehouses. It has had no choice but had to invest in the warehouse layout since there were large costs that were associated with materials handling and storage, with poor design and layout contributing to inventory problems (Eskom, 1995).

When the company is designing a layout for an existing warehouse, all the dimensions of the building are collected: the dimensions of the inside of the building and the size and position of all obstructions (pillars, steps, doorways, windows, power distribution boards, etc.) (Eskom, 1995). The stacking height is very important when designing the layout because it may affect the way material is handled (binning or issuing). Furthermore the quality of floor and loading capacity must be established. When the company is planning to design the warehouse layout for a new building, it is important that it collects data that is related to site that is required. This includes the size and shape of the obtainable area, the land slope direction, the land load bearing capacity, drainage, vehicle access and flow and climatic factors; as well as identifying if the site is owned by Eskom (Eskom, 1995). This building and site data must be provided to the appointed analyst so that he or she can decide on the physical parameters during the planning. Additionally it is imperative that all the relevant information is obtained, since any unexpected limitations or oversights becoming evident at the implementation phase could prove disastrous (Eskom, 1995).

At Eskom in KwaZulu-Natal, New Germany is the biggest warehouse. Previously, material for big projects was only kept there. Four years ago this was changed and each warehouse now services the customers that are closer to them, including providing project material. However, the layout design for other warehouses did not take this into consideration and as a result the existing layouts are not suitable or fit for purpose. The smaller warehouses were

designed to keep smaller items, but recently they are used for keeping material for projects and space is becoming a problem since the layout was not changed when the scope of work changed (Eskom, 1995).

4.10.1 Receiving areas

The receiving area must have visibly demarcated areas in order to identify material that is waiting for inspection, material waiting for goods receipts, blocked stock, stock returns, material that is waiting for binning, non-stock items that are waiting for collection by the end-user, rejected items and the items that need to be returned to suppliers for any reason (Eskom, 2013, p. 128). Moreover, the receiving area must have delivery access that permits rapid offloading, while protecting goods from extreme weather. Receipts must be documented instantly into the receiving register and SAP. However, if material is received after hours it must be documented on the register on the first subsequent working day. Approved quality inspectors must complete quality checks on maintenance goods delivered to the warehouses. It is important that all delivery notes or invoice on receipt must have an Eskom date stamp and the signature of the employee that has received the material, and if the delivery note does not correspond with the order and quantity on SAP a material discrepancy form must be filled in and the driver must sign to witness the discrepancy. Each delivery note is referenced to the purchase order (Eskom, 2013, p. 128).

4.10.2 Storage areas

The warehouses must have a demarcated storage area, where the material that is recorded as inventory on SAP is kept in the appropriate storage area. Furthermore, the storage area must be aligned with the agreed policies, procedures and legislative requirements. A compliance certificate must be obtained for all hazardous materials (Eskom, 2013, p. 129).

4.10.3 Issuing and dispatch areas

Warehouses must also have a demarcated issuing or dispatch area where the material that has been processed from the system and is ready to be dispatched is held. When the material is processed and not picked from the bin location while it is waiting to be collected it must be either removed to a separate area and must be properly marked with all necessary details so that it can be identified easily for counting purposes (Eskom, 2013, p. 129). A picking register must be implemented to control all picking tickets that are handed to the storage

section from the issuing section and it is recommended that material must be picked when the transport order is received. However if the material has been picked and is not collected within three days, or 7 days in the case of material for CNC's and projects, it must be returned back to stock and a cancellation processed on the system. If contingency goods are issued without the above procedure, they must be recorded on a register with all applicable signatures, issue data and material document numbers. Finally the verification of all contingency good issues must be approved by the senior supervisor and the administration controller (Eskom, 2013, p. 129).

4.11 Material handling

Material handling comprises the tools and systems that can be used to move material physically. There are different ways of handling the material at Eskom and it depends on the type of material, however there are pictorial markings on the material that comes from the supplier which guides the employees in the warehouses or regional distribution centres on how they should handle that particular material. When the material is handled at Eskom RDCs, operators are trained and accredited in accordance with the Eskom policy, which states that employees must have the appropriate permit to perform a task. This is to ensure the safety of staff. The storage equipment such as forklifts, bell loggers and pallet jacks are designed to accommodate the precise requirements of the material stored and to ensure that it is handled safely and is easy to access it when it has to be issued. Eskom tests all equipment quarterly as well as yearly as it is a requirement for Occupational Health and Safety Act (OHSA) (Act 85 of 1993) and the Hazardous Substances Act (HSA) (Act 15 of 1973). Moreover, the standard of housekeeping, safety and loss control is upheld as it is mandatory under Eskom procedures, OHSA, HSA and other relevant legislation such as that concerning the environment.

4.12 Reverse logistics

Reverse logistics at Eskom occurs when the material is returned to the regional distribution centres from customers (major projects, minor projects or customer network centres (CNC's)). The process starts with a review of the returned material documentation and a check of the physical material against documentation. If it is in good condition it must be returned to stock but if it is not in good condition employees from the standard implementation (SI) department are required to check if it is fit for use and can be returned to

stock or it is not fit for use then it can be scrapped. Reverse logistics is one of the activities that affect the warehouses of Eskom in KwaZulu-Natal since there is a great deal of inventory that is being returned from project sites. These returns are coming in large quantities and in most cases they arrive in bad condition and as a result they end up being scrapped.

4.13 Conclusion

Based on an analysis of inventory management at Eskom, the chapter described policies that are in place to control activities in the supply chain and the way they are designed to operate. It explained the organisational structure at Eskom, then it described inventory policy, the inventory system, warehouse management, order processing, logistics communication, warehouse location, warehouse layouts, procurement and reverse logistics within Eskom.

The company operates with a clear set of guiding principles and procedures which have been designed to ensure that procurement and inventory management are carried out ethically and responsibly. However, the researcher's own experience suggests that the practical application of the system results in wastage and inefficiencies. This was further investigated through interviews with material management staff in the Eskom RDCs.

The next chapter presents the research findings and contextual influences on inventory management at Eskom.

CHAPTER 5: RESULTS

5.1 Introduction

Chapter 4 discussed the policies that are in place to control procurement, logistics and inventory management at Eskom. It described how the system is designed to run, and the kinds of materials that are held in inventory within the organisation. In this chapter, the data collected through the interviews with the selected staff at Eskom Holdings is presented. Firstly, it describes the participants' profiles and then proceeds to give an overview and discussion of the results of the interviews. It explains the way in which the designed management system fails and other perceived problems as described by the participants in the study.

5.2 Response rate

The rate of response in this study was 86.7% because only 13 participants out of the proposed 15. Up until the completion of this research project appointment could not be made with the remaining two people because they kept postponing meetings.

5.3 Participant profiles

The participants were grouped according to the departments: 8 from the material management department, 4 from project management and 3 from procurement management.

5.3.1 Material management department

MM1 is the materials management manager with experience of over 30 years within Eskom. He is responsible for material requirements planners and warehousing team in New Germany, Colenso and Marburg. His role is to:

- Manage the supply function and ensure that procedures are adhered to,
- Manage the optimisation of the materials management operation function,
- Analyse and plan inventory management,
- Ensure good financial management within business unit,
- Manage materials management operations performance,
- Report key performance indicators(KPIs)
- Collaborate with internal and external stakeholders.

MM2 is senior warehouse supervisor at the New Germany RDC with experience of over 15 years within Eskom. He supervises 2 warehouse supervisors and he is responsible for:

- overseeing the entire warehouse operation including the optimisation of trucks,
- Supporting the materials management manager to close off audits findings that are identified.

MM3 is working as the senior material requirement planner for the Howick and Colenso RDCs with over 10 years work experience. Her role is to:

- consolidate forecasted (12-24 months) material requirements per item through liaison with clients,
- decide on optimal material planning parameters per process line,
- optimise inventory management, by maintaining availability for customers and turning over stock,
- negotiate with suppliers on behalf of end-users,
- compile reports on available inventory

MM4 is working as warehouse supervisor at New Germany Regional Distribution Center with over 15 years work experience within Eskom. She is supervising 11 staff. Her responsibilities include:

- allocate receiving and issuing activities on daily basis,
- co-ordinate relevant training with training department for staff training to ensure that safety processes are followed,
- liaise with other departments and suppliers for any request on hand,
- participate in day-to-day activities with inventory issues and making sure they are resolved timeously,
- ensure that all transactions are processed correctly and on time, documents are filed properly,
- Attend meetings to respond to customer issues.

MM5 is working as the senior warehouse supervisor for Empangeni and Vryheid Regional Distribution Centre with over 6 years work experience within Eskom. She is supervising 16 employees and she is responsible for:

- supervising the warehouse activities such as receiving, issuing, storage of material, housekeeping and maintaining the accuracy of the inventory,

- Keeping health and safe work conditions for the employee within the RDC.

MM6 is working as senior advisor supply chain planning for KwaZulu-Natal Operating unit with the experience of over 15 years. She is supervising 4 senior material planners and responsible for:

- Material forecasting and material parameters for the operating unit,
- Liaison with suppliers for delivery dates and contract managers that manage contracts for all items.

MM7 is working as warehouse supervisor for Colenso Regional Distribution Centre with the experience of over 7 years. He is supervising 4 employees and responsible for:

- Supervising warehouse activities such as receiving, issuing, storage of material, housekeeping and maintaining the accuracy of inventory,
- Keeping health and safe working conditions of employees within the RDC.

MM8 is working as warehouse supervisor at Marburg regional distribution centre with the experience of over 15 years within Eskom. He is supervising 7 employees and responsible for:

- Supervising the warehouse activities such as receiving, issuing and storage of material, housekeeping and maintaining stock accuracy,
- Keeping health and safe working conditions of employees within the RDC.

5.3.2 Project management department

PM1 is working as the project coordinator for minor works in the Pietermaritzburg area. He has over 22 years of experience within Eskom. His role is to:

- Drive minor works projects from the beginning whereby customers make commitment by paying Eskom to provide electricity for them,
- Make arrangements to survey and design the electricity for customers,
- Arrange availability of material then appoint the contractor that will do the job for customers,
- Arrange checking and testing of electricity after the contractor has worked.

PM2 is working as the project manager for electrification projects in Empangeni, Vryheid and Newcastle area; he has over 17 years of experience within Eskom. He is responsible for:

- Managing projects,

- Appointing contractors that will execute the project,
- Ensuring that the allocated budget is used efficiently,
- Ensuring that the contractors have built project sites that meet Eskom standards.

PM3 is working as the senior supervisor at Ulundi customer network centre (CNC). She has over 10 years work experience within Eskom. Her role is to:

- Oversee the operation of the CNC whereby she arranges and schedules the maintenance of the lines,
- Supervise team that is doing line patrolling,
- Arrange and keep material for maintenance and breakdown,
- Appoint contractors that will be working on planned maintenance,
- Arrange standby for employees that will restore electricity.

5.3.3 Procurement department

PR1 was the first employee that participated in the study at the procurement department. She is working as the senior adviser with more than 15 years of experience within Eskom. She is supervising 7 buyers that purchase various goods, machines, equipment, spares tools etcetera. She is responsible for:

- Guiding and advising buyers on their transactions,
- Establishing contracts for strategic commodities,
- Processing complex rare transactions,
- Approving buyers purchase orders and
- Providing forex purchases with their forward cover.

PR2 is working as the procurement officer with over 9 years work experience within Eskom. He is responsible for:

- Establishing new contracts for suppliers that will provide goods and services for Eskom,
- Advertising tenders and closing them,
- Participating in the evaluations of bids that were received after the tender is closed
- Preparing the award letter for the successful supplier.

5.4 Demand influences on inventory management

Generally, demand is the consumer's need or desire to own the product or experience a service. At Eskom demand represents the need of consumers for electricity but to maintain this supply and extend it to new customers requires materials that are managed by the material management department. The aim of this section was to determine how Eskom assesses its demand, how it responds to it and how it identifies the causes of having excessive or shortages of inventory. According to MM3:

The decision of how much to order and when to order is done through two approaches, a responsive approach and an anticipative approach; the responsive approach applies when the senior requirement planners wait for customer requirements to be created on the system, then place orders for those requirements by following supplier's lead time; the anticipative approach is normally used for maintenance material where the senior material requirement planners will look at the historical usage per item and order in advance for future so that the material is readily available for breakdown and unplanned maintenance.

MM6 also affirms that the inventory policy states that the material requirement planners must respond to demand that emanates from projects, for example they must buy the exact material that is on the bill of quantity not one item more or one item less. She added that the maintenance material must be bought by following minimum and maximum stock levels per item. For major projects (including electrification) material must be bought as lot for lot, meaning the end- user needs to send their requirement for material and then orders are placed. For maintenance material the historical usage at the CNC must be considered and orders can be placed according to that information, as rightly asserted by MM8, MM1, MM7, MM5 & MM4. Therefore, PM2 concludes that:

It is difficult to make decisions as to how much to order since there is no communication throughout the value chain, as the result anyone just assume the quantity that will be ordered and in most cases it is incorrect.

Eskom uses the SAP internet enabled system for inventory management. Stock inaccuracy is the discrepancy that exists between the physical available material on the shelves and the material that is listed on the system, (Wagner et al., 2017, p. 118). The assumption is usually

made, when managing inventory, that inventory levels are accurately known: that inventory records in the system are always equal to the actual inventory on the shelves. However, this is often not the case (Sethi & Shi, 2013, p. 1). In the case of Eskom, this may mean that more stocks are held than they are recorded in SAP, or that stocks that should be in the warehouse are not. This finding is illustrated by PM1 that:

The six Eskom warehouses in KwaZulu Natal are having lopsided material whereby some items are short particularly poles and cross arms, transformers, mini subs, RMU's, cables and conductors, meters, pole top box, the list is endless when line hardware has to be considered; and some are surpluses whereby they are not needed altogether and this is affecting us negatively since we are unable to execute our projects as the result customers are unhappy, Eskom is losing money because there are no sales since we are not connecting people to electricity and we are unable to meet our target.

Both materials management employees and project management employees that participated in the study agreed that the KwaZulu-Natal operating unit has a problem with unbalanced stock and they mentioned various causes of this situation. For instance, MM6 reckons that:

Eskom is having imbalance levels of stock because internal customers are providing incorrect requirements for their material, the planners within the material management are purchasing incorrectly, contracts with suppliers are not in place (this is resulting in buyers or planners buy too much inventory because it takes long to source it when there are no contracts in place .

Problems described by participants included:

1. Surplus material due to projects that get cancelled after the requirements for material has been submitted to material management, and the material become surplus because it was already ordered (MM1, MM4, MM7, MM8 & MM3). This finding was further illustrated by (S. MM2) that:

The maintenance & operations (M&O), asset creation are the units that influence the management of inventory, with their improper planning where they will put reservations on the system that have large quantities of

materials; then the material will be ordered when it is available in the warehouses or RDC's they will not take it because the project sites are not ready or the project itself does not have funds.

2. Overstocking due to inaccurate forecasts by material requirement planners who buy more than they are supposed to and that material end up not being used because there was no demand for it from the beginning.

3. Shortage of material due to poor planning from our end-users (electrification department and customer network centre department) because *they request material too late, without considering lead times and we fail to supply since suppliers needs a certain period of time to manufacture each material* (MM1). This finding is supported by MM6 that:

Eskom is having imbalance levels of stock because internal customers are providing incorrect requirements for their material, the planners within the material management are purchasing incorrectly, contracts with suppliers are not in place (this is resulting in buyers or planners buy too much inventory because it takes long to source it when there are no contracts in place).

4. Imbalances due to poor communication between MRP and end-user: Senior material requirement planners are placing orders based on the reservations that are in the system without contacting the end-user to ensure the correctness of requirements that are placed on the system. Material is then delivered to the RDC's only for the MMD to find out that end-users do not need all of the material, since they mistakenly entered their requirements As a result, the material ends up sitting in warehouses without any need for it (MM5). She indicated the example whereby the end-user initially needed 2000 metres of wire strand that is sometimes measured in each roll of 100m (EA) or metres (M) on SAP. The reservation (request) that was created by end-user was 200 (EA) whereas they in fact required 200 M. The senior material planner ordered as per the reservation even though they are aware that this particular item may be indicated as EA or M on SAP. The warehouse is now sitting with 19800 metres of surplus of this particular material. An ordering anomalies that MM2 describes thus:

There is too much volatility in planning from the end-user's point of view, since they are not providing the accurate requirements for their material and

the senior material planning end up buying incorrectly and also the traditional method of forecasting (based on assumptions) is a problem as it is always inaccurate.

5. Overall demand planning: A crucial aspect of Eskom's planning is the accurate assessment of the demand for electricity and the consideration of different approaches to managing and satisfying this demand (Pasom, Therdyothin, Nathakaranakule, Prapanavarat, & Limmeechokchai, 2015, p. 1016). Eskom can measure or assess its demand by looking at the requests for electricity from customers as well as assessing the consumption patterns of the customers that already have an electricity supply (PM2.). However, as a state-owned service industry, the company has been responding after customers have made their demands on the system rather than assessing requirements in advance (MM6). The ultimate demand is created by end-consumers and the stakeholders of the company, especially redistributors, need to collaborate and share customers' requirements so that Eskom can plan accordingly to ensure that these demands are met. However, this is not happening at Eskom because people are used to working in silos, according to PM1. Referring to Eskom, other buttress that:

We respond to demand after the end-users have put reservations on the system, then we monitor them daily or weekly so that we order material accordingly, for project material we order lot for lot, for maintenance we look at the usage or trend between two to three years to see how much they have used per item, then set parameters in order to have minimum and maximum per item so that the system can prompt us to order when the item has reached to certain number (MM1, MM2, MM3, MM7).

6. Stock monitoring: According to MM8 material planners need to monitor stock levels on SAP system and flag them when the reorder point has reached, and this can be efficient when there are accurate minimum and maximum stock level. The explanation given by MM5 illuminates this finding that:

At the material management department, our two major customers are maintenance customers that are known as customer network centres (CNC's) and electrification, minor and major customers; therefore we can respond to CNC's demand issuing the material that they have placed on the system (the material requirement planners will prompt the RDC's or warehouses to issue the material); for electrification, minor and major project we can respond to

their demand by issuing material that they have placed on the system as well (the material requirement planners send dispatch requests to RDC's or warehouses and the material is issued according to the dispatch request).

5.5 Supply chain structures

Supply chain includes individuals and the businesses that contribute in producing the products from raw materials to finished products. This section intends to outline the various segments of supply chain that influence the management of inventory, by identifying how procurement department works with other department to develop contracts and finally to identify decision-making processes with regards to ordering.

According to MM6 there is little influence from different segments of the supply chain because there is clarity in roles, meaning that each department or unit has its role and it is clearly documented on Eskom policies and procedures. However, the material requirement planners and senior material requirement planners decide what should be kept in stock and they may be influenced by other departments when they decide what should be kept in stock. Therefore according to MM2,

The maintenance & operations (M&O), asset creation are the units that influence the management of inventory, with their improper planning where they will put reservations on the system that have large quantities of materials; then the material will be ordered when it is available in the warehouses or RDC's they will not take it because the project sites are not ready or the project itself does not have funds.

5.5.1 Procurement department

The procurement department influences the management of inventory by developing contracts late. The senior material planners will be creating purchase orders to suppliers with large quantities so that it covers customers for some time and when the contracts are developed in time the senior MRPs draws the contract for the exact quantity required at any given time (MM3).

5.5.2 Suppliers

Late or early deliveries by suppliers influence the management of inventory. When the material is delivered early it occupies space in the warehouses because customers will not

need to use it at that particular time and that material will be regarded as surplus since warehouses will not be able to issue it. Late deliveries also influence inventory management because customers will be waiting for material but it isn't available. Customers then use other options such as providing permits to contractors that will be executing the project to buy the material from other sources. When that material is finally delivered there will be no need for it. (MM5, MM8, & MM7).

5.5.3 Supplier development and localisation (SD&L)

Eskom's procedures emphasise the company's role in socio-economic development. Furthermore, the company must comply with the requirements of the Preferential Procurement Policy Framework Act (PPFA) and this incorporates the requirement for local development and Broad-Based Black Economic Empowerment (B-BBEE) to be considered when procurement is carried out (South African National Treasury, 2017). Eskom has a supplier development and localisation (SD&L) unit to ensure that this obligation is met. Although procurement is the department that obtains suppliers that will provide goods and services to the business and is responsible for developing contracts and buying goods and services that the business may require, SD&L works with the procurement department to develop contracts with newer suppliers that will provide material to Eskom. They have the responsibility to identify, train and develop small suppliers that were previously disadvantaged (youth, black women, black women with disabilities etc.) so that they are given a fair chance to supply Eskom with goods or services that may be needed. (MM1)

5.6 Information availability and forecasting

A healthy supply chain requires effective information sharing in order to improve the supply chain management environment as a whole as well as supply chain performances in order to meet business needs (Zhou & Benton, 2007, p. 1348). Furthermore the information sharing is used for supply chain planning in order to create accurate forecasts of future demand and to co-ordinate different functions within the business such as customers, suppliers and internal operations (Zhou & Benton, 2007, p. 1349).

5.6.1 Information used for forecasting at Eskom

The material management department uses historical usage from SAP to forecast for maintenance material, and to forecast for electrification, minor works and major projects they

use requirements from customers that are placed in the SAP system (MM3, MM1, MM2, MM8, MM7 & MM5). In a rather supportive tone, MM6 opines that:

Eskom does not have forecasting tool because we are using historical information that does not produce good result, this contribute negatively in the management of inventory.

According to PM1 also, forecasting is done by checking how many customers that applied for electricity in the past year 3 years, and then compare those years to see if the demand became high or low and use that information to plan for future demand. In the electrification department forecasting is done by analysing the gazette and the final design of the project from the engineers, (PM2). The field service relies on the material management team to establish the historical usage with minimum and maximum of all material type, in order to respond to breakdowns, however the forecast for planned maintenance is done after line patrolling whereby the Eskom technicians and the appointed contractor will check what material needs to be changed and that material is then ordered from the warehouses as noted by PM3.

5.6.2 Responses to over-forecasting or under-forecasting

When material is over-forecasted and it is already delivered at the warehouses or RDC's the material requirement planners optimize those particular items within different plants, whereby they will be moved from one warehouse (Empangeni, Howick, Vryheid, Colenso Marburg and New Germany) to another if there is a need for them, but if they are not needed in all plants in KwaZulu-Natal they get advertised to other regions such as Eastern Cape, Gauteng, Western Cape, Bloemfontein etc., as recommended by MM3, MM2 & MM7. However when the material is under-forecasted the material requirement planners negotiates with other regions to see if they can transfer it to KwaZulu-Natal if they have excess, otherwise they can negotiate with the suppliers for early deliveries, as acclaimed by participant MM3 et al. Therefore, the participant PM2 says that:

In our department, when under-forecasting or over-forecasting took place we do re-phasing and re-gazetting, but guided by the priority of the project

This happens when the minor works department manages over-forecasting or under-forecasting by looking at other areas (Empangeni, Pietermaritzburg, Newcastle, Port Shepstone, Ladysmith) to see if the material that was ordered is in line with the demand, and

if it is not, it is then moved around to manage the bottom line for the purpose of complying with finance and budget, according to participant PM1.

5.6.3 The impact of forecasting on stock level

Eskom is using historical usage to do the forecasting and it is always inaccurate because the end-users are putting incorrect requirements to the system or the material requirement planners are doing it incorrectly, therefore participants MM1, MM3, MM2 & MM6 submits that this impacts on the stock levels within the business. However, participant PM1 argues that:

Forecasting does impact stock level because we are using historical information for customers that requested electricity in the past three years to determine the current need of material, when forecasting is incorrectly done and the material is not available when it is needed, customers choose the self-build option where they will approach the contractor directly to buy material and execute the project, as a result Eskom ends up with material that is in excess since the order was already done for material but the customer did not want to wait for unavailable material.

According to (PM2), forecasting can have impact on stock level if it was done based on estimate instead of using final design package from the engineers.

5.6.4 Information for better forecasting

To change this situation the materials management department needs to collaborate with project team during the initiation stage of the project as opine by participants MM1, MM3, and MM2 & MM6. According to participants PM2, PM3 & PM1, the business needs to improve on communication in different departments so that all projects that will take place in each financial year are known and each stakeholder can prepare their parts, for example, place accurate reservations or requirement on the system so that material requirement planners can order correctly. Therefore, participant MM5 says that lot of planning is needed by all stakeholders of the business.

5.7 Business goals

Generally, business goals exist to assist the business to grow and also accomplish its objectives. Successful businesses are combining goals and operational objectives in order to determine the direction of the business.

5.7.1 The business goals of Eskom as viewed by the participants

The goal of Eskom is to supply electricity to the nation and support the economy of the country particularly meeting industries requirements as well as making the lives of people better, participant MM1 affirms. MM4 added that Eskom has obligation to keep the lights on at all times, reduce costs and increase savings. According to MM6, Eskom needs inventory to be available at all times so that the business is able to keep the lights on at all times, thus contributing to the security of electricity supply. Furthermore, participants MM7, PM3 & PM2 pointed out that the business may save significant funds if it can diminish excess stock. The goal of Eskom is to ensure that it provides and sustain electricity to its customers. Therefore participants MM8 summarises thus:

The goals of Eskom are to be one of the top 5 utilities in the world by providing sustainable electricity.

5.7.2 The impacts of inventory management on Eskom goals

According to MM1, Eskom goals will be impacted if the inventory is not available at the required time, because that will mean the projects will be delayed, and the networks that are already existing will also be affected because the restoration time will take longer than it supposed to be.

Participants PM2, PM1 & PM3 stated that when the required inventory is not available at the given time Eskom is losing money from sales because people will not be buying electricity, furthermore the business will also be losing money because contractors will be paid standing time if they can't proceed with the project as the result of shortage of inventory

5.7.3 Impact of imbalance inventory on the business goals of Eskom

The imbalances in inventory have an impact, whether there is a shortage or excess of stock. The participant MM1, indicated that when the inventory is in excess it means that the business has money that is tied up in stock and is not available to be usefully employed

elsewhere to increase profits. Furthermore, both participants MM1 & MM2, added that this inventory also deteriorates and then the business loses money since that inventory will be scrapped. On the other hand MM3 articulates that when inventory is short, it will mean that the business will be unable to electrify new sites, also breakdowns could be affected since the restoration time can be longer.

5.8 Participant suggestions for improvements to inventory management

During the investigation, participants were allowed to recommend how to improve on the management of inventory in Eskom. Below are some of their suggestions:

1. Participant MM1 suggests that the procurement department needs to ensure that the supplier contracts are always in place, because if contracts are not in place, the material requirement planners are pushed to order more so that the business does not struggle while waiting for new contracts (this creates unnecessary excess stock).
2. Participant MM1 also recommends that material planners need to ensure that delivery dates are acknowledged by suppliers when placing orders and expediting must be done continuously to avoid shortage of material.
3. The warehouses need to ensure that all control measures of stock such as cycle counts, independent stock counts, spot checks and wall to wall checks, are done timeously in order to improve stock accuracy. If there are discrepancies, adjustments must be done so that the stock will balance all the time, this point of suggestion was raised by participants MM5, MM8, MM7, MM2, and MM4. On this note participant MM3 submit that:

Constant customer interactions is required at all times especially at the beginning of the project, because this will assist in buying accurate material that is needed to the particular projects, and also when there are deviations or changes in scope may be known early and the material requirement planners will prepare for them in terms of providing the material.

5.9 Conclusion

This chapter presented and discussed the data collected through the interviews of the selected staff at Eskom Holdings. Firstly, it profiled the participants in order to know who they are and their portfolio in the organisation. The chapter also give an overview and discussion of

the participants' contributions under the headings suggested by the conceptual framework. Explanations were sought for the way in which the designed management system fails and other perceived problems as observed and described by the participants in the study were described. The next chapter discusses these research findings in response to the research objectives. This leads to the generation of recommendations, which are presented in the final chapter.

CHAPTER 6: DISCUSSION OF RESULTS

6.1 Introduction

The aim of this study was to investigate features of inventory systems that result in inefficiencies within Eskom's Distribution Division in the KwaZulu-Natal Operating Unit. The survey covered five of the six Eskom warehouses or regional distribution centres: Empangeni, New Germany, Marburg, Colenso and Howick. Participants from the procurement department and project management sections (minor, electrification and maintenance) were also interviewed. The data collected through these interviews was presented in Chapter 5 and are discussed and interpreted in this chapter in response to the research objectives and with a view to generating recommendations.

Guided by the model of inventory management developed by Haines et al. (2010, p. 113), qualitative data were collected and examined in order to respond to the research questions in Section 1.6. Qualitative data were collected through the interview of senior and intermediate staff of the warehousing, planning, procurement and project management departments that carry out operations and activities within material management. The data were analysed using content analysis to relate the elements generated from the literature review to the research findings using the conceptual model to provide structure. The data presented in Chapter 5 was analysed with the themes from the literature and participant observations to achieve a holistic analysis. Also, some of the earlier discussions were revisited to support the arguments in this analysis.

The six research questions were:

1. What are the features of Eskom's inventory system?
2. How does Eskom integrate demand from its project teams into the management of inventory?
3. How does Eskom's supply chain structure influence the management of inventory?
4. How does the availability of information affect Eskom's management of inventory?
5. How do Eskom's business goals affect decision-making in materials management?
6. How can the decision making processes affecting inventory management at Eskom be improved?

Inventory management is the business function that monitors the properties, quantities and location of items held in stock (Dooley, Yan, Mohan & Gopalakrishnan, 2010, p. 12). The model of inventory management describes the effect of ordering inefficiencies on inventory levels and customer service as the result of decisions made based on perceptions, the effects of the operational and environmental context in which the supply chain operates and the outcomes of decision making processes (Haines et al., 2010, p. 113). The diagram (Figure 2.3) of the conceptual framework for inventory management summarizes the connectivity of the core variables (Section 2.14). This chapter discusses these variables as they impact on inventory management in at Eskom Holdings, under headings which respond to the research questions.

6.2 Features of Eskom's inventory system

Chapter 4 investigated the procedures and practices which have been developed to manage inventory at Eskom. The elements of the inventory management system at Eskom are the demand-planning function, the procurement division, suppliers, warehousing (material management), end-users (projects and maintenance) and final consumers of electricity. The literature review described features of inventory systems that result in inefficiencies; it also found that demand, procurement, information, business goals and decision-making impact on the management of inventory.

The Eskom procurement policy (Eskom, 2014B, p. 34) identifies two ways in which the procurement chain may be initiated: by end-users (project managers) or inventory optimisers (warehouse managers) for items that are held in stock. For projects, ordering should take place after the project has been approved for execution. The project management department, in collaboration with the engineers and designers, generates the bill of material (BOM), and then forwards it to the material management department (planning) for ordering and onward communication to the relevant suppliers. Suppliers acknowledge the order and commit on the delivery date, and when the material is ready the logistics department is contacted for transportation to the warehousing department. From the warehouses the required materials are issued to the end-users accordingly. This description and the documentary evidence indicate a logical system that should function to provide service delivery, but the researcher's experience and that of the participants in this study indicate otherwise.

In some instances, it happens that the materials issued to the end-users are rejected based on complaints related to substandard items or deviations from specification. At this point the standard implementation department are responsible for investigating and making recommendations. This constitutes inefficiency in inventory management at Eskom, in that deficiencies are often noticed at the end of the procurement chain rather than at the beginning: quality at source is not effectively implemented in the suppliers' operations. The cost implication and space constraints could be severe on the company. Another situation is a case whereby the information provided to suppliers is not clearly specified to represent the actual requirement, even though the procedures laid down by Eskom stipulate that this should happen. Furthermore, order quantities may be either overstated or understated which could lead to surplus or shortage in stock, with resultant adverse implications for the company.

Sometimes procurement fails to develop the contracts necessary for operation, thereby creating problems for the material management department. This problem is then transferred to the material requirement planners who are now left with no option other than to buy outside the contract. However, buying this way puts them under pressure to buy in large quantities, because they want to avoid stock shortages hence excess stock is created. The model of inventory management describes the effect as decisions made based on perceptions of the operational and environmental context in which the supply chain operates (Haines, et al., 2010, p. 113). The model highlights the way in which managers make decisions based on individual perceptions and how those decisions are tantamount to ordering inefficiencies which consequently impact on the inventory levels and customer service, and the effects of feedback from the outcomes on onward decision making processes.

End-users also create inefficiencies by not placing the requests for their requirements in good time. As a result, the material management department fails to fulfil their material request and this leads to projects delays which directly impact on the business goal. When the business goals are not met, the demand is affected and hence, the whole inventory system is influenced. One of the project coordinators explained how the unbalanced inventory impacts on the business goal of executing projects to connect customers, and hence on the sales of electricity (see Section 5.3).

6.3 The impact of demand on the management of inventory at Eskom

Businesses keep inventory in order to meet the demand from their customers at any particular time (Zappone 2014, p. 1). Effective inventory management is crucial in any organisation, to ensure that a business has adequate stock to satisfy the demands of its customers. However, poor inventory management could lead to serious business loss due to material shortages, or wastage by excess stock. The model of inventory management affirms that demand influences management decisions with resultant impacts on order variability, backlogs (shortages) and carrying costs (excess stock).

According to MM6 Eskom is a service industry and therefore does not assess or measure demand, but the company only responds to it after the customers have put their demand on the system. The demand is measured by knowing the number of customers that need electricity and the stakeholders of the company need to collaborate and share customers' requirements so that each department can plan accordingly to ensure that these demands are met. However, *this is not happening at Eskom because people are used in working in silos* (PM1). These participants were referring to the demand for electricity, which was not considered in this research, although it is related to the demand for the creation and maintenance of infrastructure, which was the focus of this study.

In principle, the consumer initiates the procurement chain by their need for electricity which prompts Eskom to meet that demand. However, Eskom, as a state owned company, does not have a simple or direct relationship with all existing or potential customers. Existing customers require Eskom to maintain their electricity supply, which requires repair of infrastructure and the replacement of equipment when it reaches the end of its lifecycle. Eskom must plan this maintenance within its own structures, with the only input from customers often being when breakdowns occur. Furthermore, Eskom has a role to play in socio-economic development, so that the demand for many new electrification projects does not come directly from the beneficiaries but is generated by government in conjunction with Eskom's own planning structures.

In terms of Eskom's supply chain procedures, demand at Eskom is therefore created by the end-users within the company, who in turn impact on the management of inventory. The activities of inventory management at Eskom start with knowing the requirements of these internal customers and ensuring that the required material is made available at any given time. The participants indicated that the demand for project material comes from the project

management department and that forecasting for the maintenance materials is done by the materials requirement planners based on historical figures. However Eskom faces problems when demand is not accurately forecasted by these end-users or by the materials requirement planners. Along with long lead times for materials, this increases the requirement for buffer stock. The literature suggests that these variations in demand could be amplified backwards through the supply chain but at Eskom, demand is distorted even within the organisation and this is apparent in the excessive stock found in Eskom's warehouses.

6.4 The impact of supply chain structure on Eskom's management of inventory

In section 2.13.2 the supply chain structure was defined as the arrangement of stakeholders and the relationships between them. Thus supply chain structure refers to the framework of the links and interdependent organisations that coordinate, control, and improve the flow of material and information from the suppliers to the final customer. It includes individuals and the businesses that contribute in producing the products from raw materials to finished products.

This study was not able to assess the supply chain of Eskom beyond the role of its immediate suppliers. However, these were found to have a considerable effect on Eskom's inventory management. The interaction between internal departments and Eskom's suppliers also affected inventory.

Suppliers created inventory problems when they delivered materials later than promised and after the end-users had been forced to make alternative arrangements in order to carry out their work. The quality of materials supplied also affects the materials management department since the warehouses are required to accommodate stock that has been rejected as unfit for purpose by end-users.

Participants also highlighted deficiencies in the relationships between the procurement department and suppliers, with contracts not concluded in time for supplies to reach the end-users. Warehouse management also observed that suppliers push materials onto Eskom once contracts have been signed, delivering items that are not required to maintain Eskom's inventory levels.

6.5 The impact of information on management of inventory

In Section 1.5 of this dissertation, procedural rationality was defined as the “extent to which the decision process involves the collection of information relevant to the decision and the reliance upon analysis of this information in making the choice”. Therefore, in a supply chain, the outcome of a decision, whether good or bad, is a function of an individual’s decision-making procedures and these in turn depend on the information available to them and their interpretation of it.

This study reveals that the material management department uses historical usage from SAP to forecast for maintenance material, and that to forecast for electrification, minor works and major projects they use requirements from customers (end-users) that are placed in the SAP system. The problems with inventory that were identified in this study suggest that there are problems with both the quality of the information which is used for decision making and the ways in which the decision makers use the information that they have.

Participants criticised the use of historical data for the procurement of maintenance materials and found that this did not meet the requirements of the technicians who were carrying out the work in the field. Inventory coming into the warehouse is therefore based on projections, while stock drawn out is based on real needs and there is a poor match between the two.

Poor communication between project end-users and procurement affects inventory management as quantities and specifications are not entered correctly on the system. Furthermore, project managers do not allow enough time for procurement to successfully complete its work and emergency purchases then affect inventory levels. Participants emphasised that improved collaboration and better planning is needed.

In Section 4.5, the study revealed that information availability at Eskom is facilitated through communication technology, particularly between Eskom and its suppliers. Eskom manages its suppliers through the Eskom Supplier Database (ESD) which informs the organisation about the geographical distribution of suppliers and the logistical demands or constraints for any supply of goods or services. The supplier evaluation manager conducts regular assessments to ensure that the details of suppliers registered on the ESD are accurate, and adequate for use at any given time. The procurement practitioners, contract managers, and nominated SD&L officials liaise with suppliers on an on-going basis via a number of accepted communication mechanisms that may include a dedicated e-mail address for suppliers to communicate with

Eskom. Surveys and supplier forums provide opportunities for further engagement. In spite of these communication channels, participants indicated that supplier performance affects inventory negatively.

According to Kembro et al. (2017, p. 81), information utilisation in the supply chain has three enabling factors, which are the quality of forecast, competence in planning and information quality. All of these affect Eskom's inventory management. This highlights that it is important for different units to share information in order to prevent late information, misunderstood information and difficulty in collecting information.

6.6 The impact of Eskom's business goal on management of inventory

It was clarified in Section 2.14.4 of this dissertation that the main goal of businesses is to serve and meet the demands of their customers efficiently and to make profits in so doing. However, the participants identified the goal of Eskom, the sole, state owned supplier of electricity, as being to support the economy of the country, meeting industries' requirements and improving the lives of people.

It was apparent from the responses of participants that they saw inventory management as playing a role in contributing to the goals of the company, rather than the goals of the company guiding inventory management. This contradicts the direction of influence, indicated with an arrow, in the conceptual framework. Thus the role and importance of business goals was not clarified during this study.

Nonetheless, the business goals of sustainability, electricity provision for the people of South Africa and making a contribution to the country's economy, were clearly important to participants and contributed to their sense of purpose. Profits were not the main motivation for Eskom's material management staff.

Eskom's goals will be impacted if the inventory is not available at the required time, because that will mean the projects will be delayed, and the networks that are already existing will also be affected because the lack of maintenance will increase the time taken to restore supply when there are breakdowns. This will have implications for the cash flow of the business since customers will not be able to buy electricity if the infrastructure is not functional. It will also affect the South African economy as a whole as electricity is essential for almost all business operations.

6.7 Conclusion

At Eskom, there are major concerns in supply decision making processes and how these decisions result in the outcomes such as those described by Haines et al. (2010, p. 113), and the feedback effects that follows.

When businesses operate in such a high consumer demand and supply chain structure uncertainty, they are confronted with the high risk of supply instabilities, manufacturing and delivery delays that could eventually result in gross ineffectiveness (Sreedevi & Saranga, 2017, p. 332).

This chapter discussed the results in response to the research objectives with a view to generating recommendations to be presented in the next chapter. The analysis covered the landscapes of inventory system that result in inefficiencies. It also identified and discussed the impact of demand, supply chain structure, information, decision-making and Eskom's business goal on the management of inventory at Eskom. The next chapter summarises the dissertation, draws conclusions from the findings and presents the recommendations.

CHAPTER 7: CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

Chapter 6 discussed the results in response to the research questions with a view to generating recommendations for this chapter, thereby achieving the last research objective. The analysis in Chapter 6 encompasses the components of inventory system that result in inefficiencies. It also identified and discussed the impact of demand, supply chain structure, information, decision-making and Eskom's business goals on the management of inventory at Eskom. This chapter summarises the dissertation, draws conclusions and presents the recommendations. The limitations of the study are also discussed in this chapter, and the recommendations for future research are made.

7.2 Conclusions

It is important for businesses to have efficient systems of managing inventory so that they are able to minimise the costs associated with stock. This study concludes that Eskom's KZN cluster is facing problems with imbalances in their warehouse. The unnecessarily high volumes of stock are causing losses through materials that are damaged or become obsolete if they not used. In contrast, a shortage of inventory is impacting on the business as it is unable to meet its commitment to maintain the supply of electricity to existing customers and to extend supply to new customers.

It emerged that poor communication between end-users and procurement staff poses the greatest problem. Furthermore, collaboration with suppliers is not effective: although Eskom has a supplier development division (SD&L) suppliers are not playing their part in providing reliable deliveries and good quality materials. All stakeholders should have a fundamental understanding of customer demand and should match this with supply in order to prevent excess and shortage of stock, while meeting customer needs.

While other studies are concerned with malpractice within Eskom's supply chain management structures, this study is concerned with the way in which well-intentioned employees nevertheless contribute to inventory problems. Milondzo and Mashau (2015, p.141) referred to: "employees behaving unethically, escalation of employees ill-discipline, materials being purchased without following the set processes, company's assets getting bought for the purpose of ballooning the budget, promotion of material theft". This researcher

takes a different view from these authors, who saw the enforcement of accountability through disciplinary procedures (Milondzo and Mashau, 2015, p.143) as the main solutions to the inventory problems at Eskom. While not denying that the management of human resources presents an opportunity for better supply chain management at Eskom, the present study suggests that improved information availability and demand forecasting could result in improvements in inventory management. Employees may be more motivated to perform if they are part of an efficient system with clear and achievable business goals.

7.3 Recommendations

In order to improve its inventory management, it is recommended that Eskom reconsider its demand forecasting and its information management.

7.3.1 Inventory classification

At Eskom, the ABC classification of inventory is used to decide on the way in which different items are treated for stocking purposes. However, this system is not being applied effectively since there are stock-outs on A-class items in spite of their classification. The ABC system is a simple and popular one, developed in the 1950s, which was suitable when the manual processing of large amounts of information limited the ability of companies to implement more detailed, complex inventory classifications (Millstein et al., 2014, p. 72). Information technology has created opportunities for inventory managers to treat large numbers of stock-keeping units (SKUs) differently to ensure improved availability and lower stock levels (Boylan, Syntetos & Karakostas, 2008, p. 473). Multi-criteria methods offer a more balanced way of classifying inventory and hence deciding stocking policy. These methods offer opportunities to consider the lead times, criticality and the risk of obsolescence along with the more conventional value and volume metrics (Bacchetti & Saccani, 2012, p. 723).

Since Eskom experiences shortages of some of its most critical inventory items and this is affecting its ability to provide service to its customers, it should consider revising its inventory classification to include multiple criteria.

7.3.2 Order quantity models

The material management department in KwaZulu-Natal at Eskom uses an economic order model to decide how much stock to order. However, this is not providing reliable stock levels

for the needs of Eskom's customers. The company needs to consider alternatives, such as periodic ordering systems, so that the gap between end-user requirements and stock availability will be closed. EOQ models are not effective when demand is variable and where a spike in demand and the resultant stock-outs result in costs which are not taken into account by the model. Improved efficiency in logistics and electronic communication with suppliers should allow Eskom to reduce ordering costs so that smaller, more frequent orders are cost effective.

Frequent review of stock levels and appropriate replenishment is possible if accurate records are kept. This research found that there are discrepancies between the stock recorded on SAP and that found in the warehouses. This must be addressed regardless of the ordering system to be used.

7.3.3 Lean systems

Lean systems may also be applicable to the management of inventory in the electricity industry in Eskom's KwaZulu-Natal operating unit to avoid the purchase of inventory which is not used and ends up being scrapped due to obsolescence. This system may assist the company by ensuring that the inventory is bought as it is needed instead of buying with the hope that it will be used. In essence lean systems may be very helpful in businesses when there are plans for scheduled production or scheduled projects because it may assist the business to keep minimal levels of inventory, minimal waste and minimal space. This means that lean systems are particularly suitable for managing the project stock while maintenance stock may benefit from reference to the theory which focuses on managing spare parts (e.g. Bacchetti & Saccani, 2012; Boylan & Syntetos, 2010; Mo et al., 2014). Eskom in KwaZulu-Natal is struggling with high volumes of inventory and inadequate warehouse space to accommodate it. Moving closer to a JIT system of inventory management would increase efficiency without increasing the need for more warehouses.

Another way in which a lean systems approach could improve inventory management would be the application of lean tools such as the 5S approach to warehouse management. By sorting, sweeping, standardising, and simplifying, it might be possible to create a more organised working environment in the RDCs and hence to improve the handling and monitoring of stock.

7.3.4 Information availability

Ordering inefficiencies have an impact on inventory levels and customer service within the supply chain. It is therefore important for decision makers to have a clear understanding of environmental context (consumer demand and supply chain structure) to enable them to make sound decisions. Matching supply with demand and thereby reducing the imbalances of inventory is the major challenge that Eskom faces in its material management division.

The model of inventory management developed by Haines et al. (2010, p. 113) reflects the importance of information availability to decision makers in supply chains, as well as the feedback which decision makers receive after they have generated orders. In order to make rational decisions, material requirements planners need access to accurate information regarding end-user requirements, current stock levels and supplier lead times. If Eskom is to improve its inventory management, it must improve the communication between different departments which include project management, warehouse management and purchasing, as well as with suppliers.

Information technology offers opportunities to improve information flow in organisations. Social media can provide instant communication between different people who can provide input into ordering decisions. Whole Enterprise Social Media provides a secure, in-house option as an alternative to public platforms such as Whatsapp (Carr, 2017, p. 25). Encouraging employees in different sections to share information and making this easier through technology can help decision makers to make more rational, informed decisions. Collaboration with suppliers also improves inventory management through better estimates of lead times and supply reliability (Fu & Piplani, 2004, p. 282).

The conceptual model of inventory management used in this study can contribute to better supply chain management at Eskom because it emphasises the optimisation of information flow in order to improve material flow. It can assist decision makers to make decisions on how much to order and when, at the lowest possible cost, while focusing on the needs of customers.

7.4 Limitations

Fifteen participants were targeted, but only thirteen participated. Even getting the thirteen to participate was difficult due to their positions and schedules that they had. The time taken for university to grant ethical clearance contributed to delays in collecting data.

This study was limited to the KZN cluster of Eskom and its findings may not apply to other regions. Furthermore, the use of a case study approach means that findings cannot be generalised to a wider population.

7.5 Future Research

There is a need for further investigation into the inventory management system at Eskom since changing technology offers opportunities for improved handling of this costly resource. The business needs to have efficient systems that they can use to make inventory available to end-users when they need it while spending less.

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APPENDIX A- TURNITIN REPORT

Inventory management in the electricity industry in South Africa: A case study

ORIGINALITY REPORT

7 %	6 %	2 %	2 %
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

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APPENDIX B- INFORMED CONSENT

UKZN HUMANITIES AND SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE (HSSREC)

APPLICATION FOR ETHICS APPROVAL For research with human participants

Information Sheet and Consent to Participate in Research

Date: 04 October 2017

Greetings,

My name is Nombuso Mohubedu I work for Eskom Material Management department and I am based at Howick Regional Distribution Centre. My contact details are as follows:

Cellphone number: 072 790 7564
Telephone number: 033 239 11 09
Email address: ndlovunc@eskom.co.za

You are being invited to consider participating in a study that involves research on Inventory management in the electricity industry in South Africa: a case study of Eskom KwaZulu Natal. The aim and purpose of this research is to investigate features of inventory systems that results in inefficiencies and assess Eskom's demand management, supply chain structure, demand forecasting, decision-making processes and supply chain management decision making. The study is expected to include Eskom employees where there would be 15 participants in total, 8 from Material Management (1 from Howick warehouse, 2 from Empangeni warehouse, 1 from Colenso and 4 from New Germany warehouse,). The other participants will be from Procurement department which at New Germany and the participants will be 3. Electrification department which is in Westville will also participate to the study where there would be 4 participants. The study will involve in-depth interview procedure. The duration of your participation if you choose to participate and remain in the study is expected to be +-1 hour.

The appointment will be made prior for the interview, it can be done face to face or over the phone and the conversation will be recorded. There are no potential risks involved to the study.

This study has been ethically reviewed and approved by the UKZN Humanities and Social Sciences Research Ethics Committee (approval number _____).

In the event of any problems or concerns/questions you may contact the researcher at 072 790 7564 or the UKZN Humanities & Social Sciences Research Ethics Committee, contact details as follows:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION

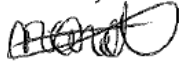
Research Office, Westville Campus
Govan Mbeki Building
Private Bag X 54001
Durban 4000 KwaZulu-Natal, SOUTH AFRICA
Tel: 27 31 2604557- Fax: 27 31 2604609
Email: HSSREC@ukzn.ac.za

Your participation in the study is voluntary and by participating, you are granting the researcher permission to use your responses. You may refuse to participate or withdraw from the study at any time with no negative consequence. There will be no monetary gain from participating in the study. Your anonymity will be maintained by the researcher and the School of Management, I.T. & Governance and your responses will not be used for any purposes outside of this study.

All data, both electronic and hard copy will be securely stored during the study and archived for 5 years. After this time, all data will be destroyed.

If you have any questions or concerns about participating in the study, please contact me or my research supervisor at the numbers listed above.

Sincerely



Nombuso Mohubedu

APPENDIX C- ETHICAL CLEARANCE LETTER



26 October 2017

Mrs Nombuso Confidence Mohubedu (207529266)
School of Management, IT & Governance
Westville Campus

Dear M^{rs} Mohubedu,

Protocol reference number: HSS/1715/017M

Project title: Inventory Management in the electricity industry in South Africa: A case study

Approval Notification – Expedited / Amendment Approval

In response to your application received on 12 September 2017 and Amendment on 06 October 2017, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL**.

Amendment

- Sample Size
- Research Methodology

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

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

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

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

Yours faithfully

Dr Shenuka Singh (Chair)

/ms

Cc Supervisor: Dr RH Salisbury
Cc Academic Leader Research: Professor Isabel Martins
Cc School Administrator: Ms Angela Pearce

Humanities & Social Sciences Research Ethics Committee
Dr Shenuka Singh (Chair)

Westville Campus, Govan Mbeki Building

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Website: www.ukzn.ac.za



Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville

APPENDIX D- GATEKEEPER'S LETTER



May 9, 2017

To Whom It May Concern:

PERMISSION TO CONDUCT RESEARCH AS PART OF THE M COM QUALIFICATION

It is a requirement of our M Com qualification that the student completes a dissertation based on research in a specific field of study. In this way students are given the opportunity to creatively link and discuss the theoretical aspects of the programme to the practical issues facing organisations in real life settings. Typically, a dissertation necessitates data gathering and the student is using interviews specifically.

Student name: Nombuso Mohubedu Student No. 207529266 has chosen to do a research project entitled:
Inventory management in the electricity industry in South Africa: a case study

Your assistance in permitting access to your organisation for the purposes of this research is much appreciated. Please be assured that all information gained from the research will be treated with the utmost confidentiality. Furthermore, should you wish any result/s or findings from the research "to be restricted" for an agreed period, this can be arranged. The confidentiality of information and anonymity of personnel will be strictly adhered to by the student.

I am available at any stage to answer any queries and/or to discuss any aspect of this research project.

If permission is granted, please sign the attached form.

Thank you for your assistance in this regard.

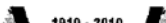
Yours sincerely

Dr RH Salisbury (Supervisor)

School of Management, IT & Governance

Postal Address:

Telephone: +27 (0) 33 260 5458 Email: salisbury@ukzn.ac.za Website: www.ukzn.ac.za


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Gatekeeper's Consent

I Stanley Sizani in my capacity as Manager hereby give permission to
Student name: Nombuso Mohubedu Student No. 207529266 to conduct research in my organisation.

The student MAY/~~CANNOT~~ (delete whichever is not applicable) use the name of the organisation in the dissertation.

Signature of Manager/Owner/Gatekeeper: 

Company Stamp:

**STANLEY SIZANI
COMMERCIAL SERVICES
MANAGER
3858437
TEL: 043 703 2536
FAX: 043 703 2008**

Date: 10/05/2017

APPENDIX E – INTERVIEW QUESTIONS

Interview guide

Inventory management in the electricity industry in South Africa: a case study

1. What is your role in the organisation?

2. Demand

- o What systems are in place for managing inventory in your department?
- o In your opinion, do we have excessive stock on some items and shortages on other items?
- o If yes, what do you think is the cause of these problems with stock levels?
- o How does the company assess and respond to demand?

3. Supply Chain structures

- o How do other sections of the supply chain (other departments, suppliers) influence the way you are managing inventory?
- o Do you work with the supply chain department to develop contracts for suppliers that will be supplying you with the inventory?
- o How is the decision made how much to order and when to order?

4. Information availability and forecasting

- o What information is used in your forecasting?
- o What do you do when you have realized that you have over forecasted or under forecasted?
- o Does forecasting contribute to excessive stock on certain items and shortage of other items?
- o If yes, describe what information would enable better forecasting.

5. Business goal

- o What do you see as the business goals of Eskom?
- o How do these goals impact on inventory management?
- o In your opinion, what is the impact on the achievement of these business goals if there is excessive or a shortage of inventory?

6. From your experience, what do you think the company should do to have a more balanced inventory? (Meaning to have the correct amount of stock on all items).