Analysing the effect of inventory management on operational performance in a manufacturing environment

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ABSTRACT

Manufacturing organisations in South Africa are perceived to be underperforming due to ineffective inventory management practices. Over the years inventory management has been criticized for being a cost center. Many manufacturing industries have recognized the importance of inventory management and the role it plays in competitive advantage. However, despite the level of attention given to inventory management, manufacturing firms are still not performing as they should, struggling to determine the minimum inventory levels that should be kept, to keep production running and uninterrupted. Therefore, finding the balance between overstocking and running out of stock, is a challenge.

This research study examined the relationship between inventory management and operational performance in a manufacturing environment. It set out to explore the different inventory management practices currently used, as well as determine the common challenges encountered on a daily basis.

A literature review was conducted on the types of inventory as well as inventory control techniques. The study made use of a quantitative research method approach, with the distribution of questionnaires through convenience sampling. The aim of the study was to provide insight into employees' understanding and competence. Further, the study aimed to address the topics of inventory management practices, inventory control, the need for warehousing, and the challenges faced when managing inventory.

The study provided several useful contributions to literature on the effectiveness of inventory management practices and the control of inventory. Furthermore, it fills the gap in knowledge on inventory management practices and operational performance in a manufacturing environment in South Africa.

Key words: inventory, inventory management, operational performance, manufacturing, inventory control techniques

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LIST OF ABBREVIATIONS

ABC Group	ABC GROUP (PTY) LTD
BOM	Bill of Material
CPFR	Collaborative Planning, Forecasting and Replenishment
DSNs	Digital Supply Networks
ECRM	Ethics in Commerce Research Committee
EOQ	Economic Order Quantity
ERP	Enterprise Resource Planning
IMS	Inventory Management Systems
IT	Information Technology
JIT	Just-In-Time
Lean	Lean Manufacturing
MBA	Master of Business Administration
MPS	Master Production Scheduling
MRO	Maintenance, repair, and operational
MRP	Material Requirement Planning
MRP II	Manufacturing Resource Planning
MTO	Make-to-Order
NWCOCI	North-West Chamber of Commerce and Industry
NWU	North West University
RFID	Radio Frequency Identification
SCM	Supply Chain Management
SD	Standard Deviation
WIP	Work in Process

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1 CHAPTER 1: NATURE AND SCOPE OF THE STUDY

1.1 Introduction

The contemporary world has had a massive wake-up call by an unprecedented disease outbreak, namely the coronavirus (COVID-19), which is considered a new strain of extremely contagious coronavirus (Boccaletti, Ditto, Mindlin and Atangana, 2020).

According to Queiroz, Ivanov, Dolgui and Fosso Wamba (2020), the coronavirus has negatively affected society as a whole and has wreaked havoc on supply chains around the globe. The effect of the pandemic on supply chains is uncharted and should prompt organisations to re-engineer and adapt supply chains to future challenges (Queiroz, Ivanov, Dolgui and Fosso Wamba, 2020).

In recent decades, many manufacturing companies have relied on long and sophisticated supply chains established over several years; applying 'just-in-time' strategies and lean ideologies put in place throughout their networks and leading to significant cost savings. However, none of these networks could prepare them for global disruptions, with nearly 35% of manufacturers announcing interference from the global coronavirus (COVID-19) pandemic (Shokrani, Loukaides, Elias and Lunt, 2020).

According to Kilpatrick and Barter (2020), manufacturing companies are heavily influenced by supply chain obstructions and have found it difficult to recover production due to delayed return of workforce, lack of personnel mobility, and travel restrictions put in place in an effort to contain the spread of the COVID-19 virus. It has been further suggested that the development of a new supply chain model is imperative; that traditional views on the linear supply chain and optimising business will transform into digital supply networks (DSNs) to enable end-to-end visibility, collaboration, responsiveness, agility, and optimisation (Kilpatrick and Barter, 2020).

With the increase in demand for products and services across economic sectors, management practices and techniques have evolved to ease the process of effective and efficient service delivery to customers and other organisational stakeholders. Organisations are increasingly making use of inventory management systems to ensure optimal management of the supply chain (Akindipe, 2014:94).

Inventory management ensures that production is uninterrupted and is economically viable, contributing to a lower manufacturing cost per product unit through the efficient use of equipment and labour (Badenhorst-Weiss *et al*., 2018:166). However, inventory management is not without its challenges. These include, among other things, materials being overstocked and eventually expiring, stock-outs, unreliable stock-taking, theft of materials by workers, and delays in delivery (Darun *et al*., 2015:311).

Inventory management within any organisation is essential to ensure the right quantity of inventory is kept. Well-organised businesses rely on inventory management to ensure that adequate inventory is available to satisfy their customers' demands and meet their desires (Awatey and Domfeh, 2014:192). The goal is to make money; matching inventory to demand is one way to achieve this. More executives have realised that holding excessive inventory is too expensive, while holding too little often disrupts manufacturing operations (Badenhorst-Weiss *et al*., 2018:166). However, according to Prempeh (2016:23), reducing levels of inventories is possible without disrupting production or having an adverse effect on sales. Staying competitive has always been a necessary effort to survive, as the nature of the competition has expanded from a local and national market to a global market (Badenhorst-Weiss *et al*., 2018:166). Thus, organisations which neglect their inventory management will jeopardise their future profitability and may result in organisation failure.

Various problems associated with inventory management include misplaced inventory locations and incorrect identification tags. These faults affect availability and turn-around time when such materials are needed. Poor inventory management such as this not only contributes to resource wastage but also increases the possibility of theft by employees working in these specific areas (Atnafu and Balda, 2018:4). Despite the overall importance of inventory management, the manufacturing environment has not given inventory management the attention it deserves and has shown an inability to engage qualified personnel to handle inventory supervision and control (Oluwaseyi, Onifade and Odeyinka, 2017:4).

Inventory management is increasingly driven by supply chain management. Modern concepts of supply chain management shift the focus on relationships between trading partners working together to control, manage and improve the flow of materials, as well as information from suppliers to end-users (Monczka *et al*., 2016). Supply chain management practices have been affected by the digital economy as over time technological advancements have progressed, which has also evolved the marketplace by changing the focus on lower price competition to focus on information technologies, quality, business process re-engineering and the combination thereof (Agrawal and Narain, 2018:1). It has become clear that more attention needs to be given to logistical decisions after the implementation of information technology (IT) and its impact on supply chain management.

1.2 Problem statement and core research question

South Africa's economy was already underperforming at the start of 2020, coming from a technical recession and the forecasted low growth, the lockdown imposed by the country to protect the population in a response to the COVID-19 pandemic has put further pressure on the manufacturing sector. As evidenced in the first quarter of 2020 where the sector's output fell by a substantial 49.4% year on year in April 2020 compared with April 2019 (Liedtke, 2020).

Consequently, many factories have been either temporarily or completely shut down, resulting in job losses. This underperforming scenario has further contributed to bottlenecks in supply chains already under pressure due to a high incidence of unplanned inventory requirements caused by a combination of challenges namely; the advent of the COVID-19 pandemic, lack of leadership, as well as the mismatch between product/service supply and demand (Liedtke, 2020).

Studies on the relationship between inventory management and the performance of manufacturing companies in South Africa is limited. Therefore, the purpose of this study was to analyse the effect of inventory management on operational performance in a manufacturing environment. The objective of this study was to bridge the gap between inventory management practices and operational performance by identifying the relationship between the two in a manufacturing environment.

1.2.1 Objectives

The main objective of the study was to analyse the effect of inventory management on operational performance in a manufacturing environment. To achieve this the research objective was divided into primary and secondary objectives.

1.2.1.1 Primary objective

The primary objective was to investigate the effect of inventory management and the possible impact it has on the performance of operations in '123 Africa'.

1.2.1.2 Secondary objectives

Secondary objectives included identification and investigation of the following:

- Where the gap of inventory control and record accuracy lies;
- The effects of stockouts on production;
- The implication of stockouts on purchasing behaviour; and

- Strategies to mitigate the adverse effects of stockouts.

1.3 Scope of the study

The study focused on the relationship between inventory management practices and operational performance of manufacturing firms in South Africa. This topic is relevant in various business sectors. This research has the potential to create an improved awareness of inventory management in the South African markets. Businesses may identify constraints within their own companies and use the tools provided in this research to address identified problems.

Inventory and stockout challenges present notable problems for production in a manufacturing environment, and as a result, has caused some companies to increase their inventory levels (Schottmiller, 2010). Increasing inventory levels is not an appropriate solution as excessive stock holdings are costly and wasteful, and in turn, place strain on an organisation's cash flow (Christopher, 2016).

The last three decades have shown immense technological progress, with new innovative products and technologies that have transformed the business environment. It has become imperative that companies explore ways to improve their effectiveness, speed and accuracy in managing inventory to stay competitive (Curtin, Kauffman and Riggins, 2007). Managing inventory will help organisations become more flexible and reliable by using visualisation of product flow, improving order accuracy, improving reaction speed, making use of 'low' to 'just-in-time' inventories, and sustaining quality (Onkundi and Bichanga, 2016). Competitive pressure on a global scale is imminent and organisations must expand their range of products or service delivery to meet the demands of the market. This has resulted in the need for an effective, automated, accurate and reliable system for monitoring and tracking data, with numerous emerging IT solutions to assist organisations in managing the rapidly changing environment (Cascio and Montealegre, 2016).

Inventory management relates to the direction and control of activities; to have the right inventory in the right place at the right time, in the right quantity, in the correct form and the exact cost (Kwadwo, 2016:24). Inventory management is essential for all enterprises because it threatens their survival. Its objective is to lower inventories and to control costs as excess inventory consumes physical space, and increases the possibility of damage, spoilage and loss. Furthermore, inventory management is in place to optimise the use of resources and identify the balance between operational requirements and minimise inventory cost to avoid stockouts (Chikán and Whybark 1990). Holding excessive stock can be quite expensive and could place strain on a company's cash flow, which could have been used more constructively to gain profitable opportunities. Inventory costs include holding costs, ordering fees and shortage costs (Drury, 2004). Holding costs relate to charges of having physical items in stock. Ordering costs determine how much is needed, preparing invoices, transport costs and the cost of inspecting goods (Drury, 2004). Shortage costs occur when demand exceeds the supply of inventory on hand. The management of inventory is crucial to the survival of a company as it affects working capital, operation and customer services. Inventory management works closely with production to achieve the main goal in manufacturing: production. Production relies on inventory management to have inventory readily available. Failure to implement effective inventory management is likely to result in production loss or stoppages on the production line. To have a successful relationship between production and inventory management, organisations need to develop their strategies to incorporate quick turnaround times that involve implementing new technologies or control measures to assist inventory control, identifying vendors that can supply stock at the correct period, and analysing stock to eliminate the risk of long delivery lead times (Munyao *et al*., 2015).

Several large manufacturing, retail, health care, and other organisations are currently using inventory management technologies to expand their use of technology to help monitor and track all inventories (Zhou and Piramuthu, 2011). It appears the potential economic impact of inventory management systems is vast and could be dominant in years to come. Therefore, it is imperative to conduct a study into the adoption of these inventory management systems from the perspective of a manufacturing organisation, particularly in third world countries such as South Africa (Brown and Russell, 2007). This study aims to increase the understanding of inventory management and how it affects the manufacturing sector in South Africa. This greater understanding could help manufacturing organisations in South Africa increase production efficiency, have better visual inventory availability, and replenish stock effectively while staying competitive.

1.3.1 Delimitations

The study classified within the field of supply chain management perspective will explored effect of inventory management on operational performance in a manufacturing environment within the South African market sector in the Gauteng province. Delimitations supply an explanation of the participants in the study, the geographic region involved, and the sector of business involved (Simon, 2011). The characteristics of delimitations are defined as inclusions and exclusions that make up the limits and boundaries of a study. These boundaries involve variables of interest, the amount of data, and the type of data that will be gathered for a study (Rubin and Babbie, 2018).

The research conducted was extensive in nature, however, the risk remained that participants would be reluctant to participate in the survey due to the unit of analysis and busy work schedules.

To avoid this pitfall, an information session was set up to explain the survey and persuade the respondents to participate.

Another limitation was the potential that respondents would not answer the survey type questionnaire from their true perception and would respond with what they thought were ethically correct answers. To avoid this, the respondents were assured that the survey was anonymous, and that all information gathered for this study would be handled in strict confidence.

The study was performed with a focus on the South African manufacturing environment. Empirical data was collected from a single source organisation.

It is important to note that these limitations of the study may lead to a conclusion that reflects the market environment of the specific region in which the study took place and may not apply across all geographical area and business sectors.

1.3.2 Assumptions

According to Rubin and Babbie (2018), assumptions are defined as the beliefs upon which the study is based on, are factual and true. These assumptions include accuracy, transparency and distribution of data. It was assumed that all respondents had a good understanding of inventory management to be able to sensibly answer the questions and that high inventory levels consume physical space, creates a financial burden, and increases the possibility of damage, spoilage, and loss (Koumanakos, 2008).

1.4 Research methodology

According to Saunders, Lewis and Thornhill (2019), research methodology is the specific procedures used to gather and analyse data about a topic. It allows the reader to critically evaluate a study’s overall validity and reliability.

This study made use of a quantitative research method approach. The research consisted of two phases; namely a literature review and an empirical study to analyse the effect of inventory management on operational performance in a manufacturing environment.

1.4.1 Literature review

The first phase of the research methodology was the literature review which aimed to give an understanding to the layman on inventory management and how it contributes to the operational performance. Furthermore, the literature review provided a background on inventory concepts, systems and what role it plays in other departments within the environment.

1.4.1.1 Inventory

What is inventory? Inventory or stock are elements in operation that have a physical presence: it’s several goods or materials held by an organisation that enables them to support the production process, satisfy customer needs and assist in dealing with the uncertainty of demand (Vrat, 2014, 21).

1.4.1.2 Inventory management

Inventory management is the process which services and maintains the constant flow of materials or goods into and out of an existing inventory (Onkundi and Bichanga, 2016). This process involves controlling the units using planning, acquisition and transferring to prevent excessive inventory and evaluating minimum inventory levels to avoid stock-outs. Holding excessive stock can be quite expensive and could put a strain on organisations’ cash flow, which could have been used more constructively to gain profitable opportunities.

The management of inventory is crucial to the survival of these entities as it affects working capital, operation and customer services. Inventory management is effective when products can be identified, balancing the ordering intervals, knowing the correct buffer stock and understanding the inventory turnover. Managing inventory can also be described as an active control program that allows an organisation to plan, organise and control inventory that will support manufacturing, sales, purchases, distribution and payments (Lavely,1996). Inventory management includes activities of forecasting and replenishment that enables a business to know how long it takes for a supplier to process goods and execute deliveries. Inventory control management is about identifying the balance between inventory investment and customer service. The objective of inventory control management is to keep inventory as low as possible while ensuring that the required stock is always available (Kamau and Kagiri, 2015). Inventory control should ask the right questions, such as:

- How much raw material is required?
- How much should be produced?
- How much stock needs to be on hand to meet operational requirements?

Inventory control is understanding how much stock is required to meet demand through forecasting. After forecasting, it is easier to determine how much to produce and how much material is needed to provide the required amount. Inventory management focusses on making the right decision to gain advantage and contain disadvantages, to create a proper balance between different approaches to managing inventory, such as:

- Keeping a smaller inventory, with more ordering points, which will increase the cost of ordering and transport; and
- Holding a larger inventory, which will increase the holding costs.

The requirement for smaller inventories is largely influenced by holding cost, which equals the total cost of capital plus the variable cost incurred through handling and storing inventory. The same funds could have been invested in something else. Further loss includes insurance, storage, tax on year-end inventory, shrinkage and deterioration (Jacob and Chase, 2010).

The need to always serve customers, lower ordering costs, setup costs, labour and equipment utilisation, transport costs and economies of scale, however, largely influences the need for extensive inventories.

Types of Inventory:

- Accounting inventories – has three categories: raw material, work in process (WIP) and finished goods. Raw materials and WIP are controlled by dependant demand. This demand moves by subjective decisions such as the production plan and stock requirements. Finished products are driven by independent desire from outside the organisation (Adeyemi and Salami, 2010); and
- Operational inventories – take four forms: cycle, safety stock, anticipation and pipeline. Cycle inventory is the portion of inventory that varies directly with lot size. Fewer, less frequent orders will require larger inventory. Safety stock is the surplus inventory that is held to protect against uncertainties in demand, lead time and supply changes. Anticipated inventory is used to absorb uneven rates of demand. Pipeline inventory occurs when an order for an item is issued but not yet received (Adeyemi and Salami, 2010).

1.4.1.3 Inventory control systems

The inventory control system is part of a policy that controls the monitoring levels of stock to establish how much to order and when to order to support production. Inventory management is the basis for an inventory management information system, which is a database of storing and administering all types of data required for efficient and accurate control. This system aims to combine different fields to keep track of all items, for example, location, requisitions, backorders, minimum levels of inventory on hand, reorder points, lead times and more. The inventory management system may interface with an Enterprise Resource Planning (ERP), which incorporates areas such as planning, purchasing, inventory, sales, marketing, finance, human resources, etc. ERP combined with other techniques can be used innovative when applied; one of these techniques are Materials Resource Planning (MRP). MRP refers to a computer-based production planning system that specifies what, how much, and when materials are needed to produce the final product. MRP is a material control system that attempts to keep adequate inventory levels to assure that the required materials are available when needed and involves both production scheduling and inventory control (Lysons and Farrington, 2006).

MRP Input Data:

- Master Production Scheduling (MPS) is the schedule for end items and indicates the amount and time frame of production items. MPS calculates the replenishment plan for items needed;
- Bill of Material (BOM) describes the structure of the products, starting from level to level, the components necessary to produce the items;
- Inventory Status identifies what is in stock and on order;
- Fundamental data identifies work in process, semi-finished goods and finished goods; and
- Lead time determining the amount of time an item will take to finish or be delivered.

The integrity of the input data is essential and should be provided by related people or machines on time and accurately. Discipline, attitude and training are essential to run a credible MRP (Gerald and David, 2000).

ERP is a process that controls and combines data from all areas of a company's resources and is designed to replace paper-based systems. ERP is an extensive information system used by employees in every department within an organisation that manages information about a company. This information includes products, customers, suppliers, employees, production facilities, financial balances, etc. (Sadrzadehrafiei, Chofreh, Hosseini and Sulaiman, 2013):

- Sales department verifies the cost of products, inventory, enters sales orders, deliveries, invoicing to customers and receive payments;
- Production department checks inventory, create production orders, manage production schedules, records the receipt of finished or in-progress orders;
- Marketing department plan, demand, and make sales forecast;
- The finance department manages accounts payables, account receivables, enter payments made by customers and payments made to suppliers, generate the balance sheet and profit and loss statement; and

- Human relations department tracks all employees, title, date of joining department and salary.

ERP attempts to integrate all departments and functions across a company onto a single computer system that serve different department's needs:

- Modern inventory control systems combine Point of Sale and ERP to control better and improve efficiency flow of information in the business process; and
- One of the modern inventory control systems is identified as Radio Frequency Identification (RFID). The RFID technology is designed to be integrated with ERP to enhance efficiency and enrich systems and processes (Gerald and David, 2000).

1.4.1.4 Radio frequency identification (RFID) technology

Radio Frequency Identification (RFID) is a wireless Auto-ID technology that uses radio frequencies to monitor and track the object or product. RFID is composed using a tag formed containing a chip connected to an antenna, which sends and receives data. This data is captured using middleware software that manages the capturing, filtering and distribution of the data (Pandian 2010, 5-6.).

1.4.1.5 Collaborative planning, forecasting and replenishment (CPFR) model

The Collaborative Planning, Forecasting and Replenishment (CPFR) model is a collaborative business approach that involves the client and the supplier working together as well as linking their computer systems to improve the efficiency of their supply chain. By implementing the CPFR model, suppliers have visibility of inventory held by the client as well as the current sales and forecasts (Rushton *et al*., 2011: 206). The CPFR had success factors as a survey of 21 companies in the USA. Sliwa (2002) reported a 57% improvement in relationship with trading partners, a 38% increase in service levels, reduced stock outages, increased sales and a further improvement in decreased inventory up to 29%. Internal communication and forecast accuracy also improved by more than 20%.

Figure 1-1: CPFR Model (Source: Rushton *et al.*, 2011:207)

1.4.1.6 Supply chain

The supply chain is a series of processes and flows that include raw material, information and money that aim to meet customer requirements and take place within and between different supply chain stages (Chopra and Meindl, 2004).

1.4.1.7 Supply chain management

Supply chain management is about managing the flow of materials, integrated planning, co-ordination and the associated flood of information to optimise goals and activities that will meet requirements with other organisations (Cooper *et al*., 1997).

Supply chain management practices have been affected by the digital economy as time, and technological advancements progressed, which also evolved the marketplace by changing the focus on lower price competition, to a focus on IT, quality, business process re-engineering and the combination thereof (Momanyi and Sanewu, 2014). In the digital economy, it became clear that more attention needs to be allocated to the logistics decision areas after implementation of IT and its impact on supply chain management.

Many firms have been negatively impacted by inventory management, which also indicates how successful supply chain management is in business sectors, particularly in the manufacturing industry. Developing countries, such as South Africa have adapted and implemented IT to some extent, sharing information to suppliers, which reduce the negative impact from the bullwhip effect. However, not all companies have the funds to implement IT to its full potential.

This research study aimed to identify the IT impacts on inventory management and the barriers that may exist within supply chain management that prevent the integration, acceptance and utilisation of IT. Coordinated empirical research investigated the perceptions of users at different levels of the supply chain management, which will help the organisation identify possible barriers like behavioural, psychological or organisational policies and technical know-how that could cause constraints. The purpose was to assist organisations in making the most of their investment in IT systems by pursuing opportunities to implement the correct strategies to control inventory more efficiently. IT influences many aspects of inventory management, such as supplier-buyer relationships, the accuracy of demand and on-time delivery.

Overloading decision-makers with information could be a potential barrier to adopting supply chain management technology as seen with the study done by Kim and Umanath (2005:814) where they measured the transfer of electronic information to assess how integrated business processes are between organisations. The pace of technology adoption was identified as a potential barrier by Power (2014) and highlights the need for supply chain management strategy and corporate strategy to be integrated to stay ahead of the growth.

1.4.2 Empirical investigation

1.4.2.1 Description of overall research design

The questionnaires were managed through a survey type and allowed perspective on the characteristics, attitudes or behaviours of the sample group. These detailed survey type questionnaires obtained information from the sample group. The research was to contain empirical data as its primary focus of the study.

For this study a cross-sectional approach was used. Cross-sectional studies involve looking at data from a group of people at one specific point in time. This approach is observational in nature and makes use of information that is present in a population to identify characteristics that exist in a community, such as: age, income, gender, etc (Kumar, 2011).

Cross-sectional studies look at a group of people at a given point in time and describes what is happening at that present moment. The data collected can be used to support further research and experimentation. Cross-sectional study cannot provide proof for certain behaviours that causes the condition but can point to a relationship worth investigating further.

Data is often obtained using surveys and researchers are then able to amass large amounts of information from a large pool of participants.

1.4.2.2 Population sampling

The unit of analysis was the support staff members of production, that support the manufacturing activities. These activities include design, planning, distribution and fabrication, all of which supports the manufacturing process.

Kumar (2011: 194) defined the sample size as the number of staff members from whom the data will be collected, it is symbolized by the letter n. The focus was the management of inventory and how it effects operational performance in a manufacturing environment. The questionnaires were distributed to 100 employees across various occupational levels who support the manufacturing activities. It was a diverse group of people with different skills sets on different levels, reporting to their respective managers across the supply chain. By using this group of employees, the intention was to identify the diversity of the group ensuring a higher probability of accuracy and easier statistical analysis.

This study, because of sampling size being significant for the quantitative analysis, made use of probability sampling (Maree, 2016). Probability sampling draws randomly from a wider population. The probability sampling used in the research is simple random sampling. With simple random sampling, it supplies all members with an equal chance of being selected, without any involvement from other individuals, each participant chosen is entirely independently (Cohen, Manion and Morrison, 2017). The study classified within the field of supply chain management perspective explored the effect of stockouts in a manufacturing environment when inventory is not available in a manufacturing environment within the Gauteng province. Delimitations supply an explanation of the participants in the study, the geographic region involved, and the sector of business involved (Simon, 2011).

It was not difficult to gain access to the unit of analysis, as this research aimed to identify the problems at hand which could be beneficial to all departments. Limitations of the study were that participants were voluntary and may not have chosen to respond (Simon,2011). Conclusions could reflect a specific region where the study took place and might not apply across other areas, as well as other business sectors, could all be limitation to generalizability. Busy work schedules may also have limited respondent participation.

Given the context of the primary research question, the sample population described in question five was the most suitable to answer the research questions. The population group was directly related and integrated in the research question, as the group assessed the effect of inventory management on operational performance in their department.

1.4.3 Data collection

The research made use of quantitative questionnaires and data was collected to interpret the result.

1.4.3.1 Quantitative techniques – measuring instrument

The quantitative data for this study was collected using a survey in the form of a questionnaire which was given to internal and external stakeholders to fill in. Quantitative data tries to make sense of how participants are reacting to a particular event that has happened or is going to happen; it seeks to understand people's perceptions, attitudes, understanding, knowledge, values and feelings of the event. This questionnaire was structured in such a way not only to supply the researcher with patterns but also allowed observation of comparisons across the sampling group (Cohen, Manion and Morrison, 2002). The answering of the questionnaire was voluntary and disseminated through the structures of the NWCOCI-North-West Chamber of Commerce and Industry.

The questionnaire was made up of patterns and observed comparisons for data analysis. It also contained dichotomous questions, multiple-choice questions, as well as rating scales which were straight forward.

The questionnaire was split into four sections namely:

- Respondent and business profile – which gave background on the respondent;
- Inventory (stock) management practices – which gave background on how respondents understand the practices;
- Challenges faced when managing stock – which gave background on the challenges and feelings respondents have; and

- Crisis management practices – which gave background on how respondents understand the practice in a crisis scenario.

1.4.3.2 Data analysis

Data analysis was conducted through a collaboration with the NWU Statistical Consulting Services.

1.4.3.2.1 Assessing and demonstrating the quality and rigour of the proposed research design

This section determined the quality of the secondary data and discussed the reliability and validity of the data.

1.4.3.2.2 Quality of secondary data

Using the data in the study using surveys was collected from various interactions with different organisations in South Africa. The survey was entirely voluntary.

1.4.3.2.3 Reliability

The data was reliable and collected upon interactions with the different groups with their consent. Information collected was based on three main types of reliability:

- Inter-item reliability: the questionnaire used multiple-choice questions;
- Test-retest reliability: was not be used in the questionnaire as respondents were not asked to fill in the same questionnaire twice; and
- Inter-rater reliability: relates to behavioural testing which is also not included in this study (Fallon, 2016).

1.4.3.2.4 Validity

The validity established the strength of a survey instrumenting the data yielded from the data collection process, which allowed for greater confidence in the interpretation of the results (Burton and Mazerolle, 2011, p. 27). According to Morling (2015), the reliability terms need to be verified and checked when using research instruments. Is the research reliable, valid and of good quality?

1.4.3.2.5 Research ethics

Considering that the proposed study involved human participants, ethical guidelines were significant when conducting this research. A specific code of ethics is set, to which research and other different professions must comply when it comes to research (Kumar, 2011). Fulfilling the requirements set out in the North-West University ethical guidelines for research, the following were adhered to:

- Consent letter and permission was obtained from the selected organisation to commence with the research;
- Sources used in this study were acknowledged and referenced as per the North-West University referencing guide;
- The study was not funded in any way; and
- The research study received ethical clearance from the Ethics in Commerce Research Committee (ECRM) of the university.

1.4.3.2.6 Right to privacy and confidentiality

The questionnaires collected with participants permission contained no identifying information that answered the survey in the various interactions. In addition, the respondents were informed that their participation was voluntary and were assured that the data was held in strict confidence and used for research purposes only.

1.4.3.2.7 Use of data source

Data used is for research purposes only.

1.4.3.2.8 Use of the findings

The findings were used for academic purposes only to complete this research paper as part of the Master of Business Administration (MBA).

1.5 Layout of the study

The proposed design for this research is as follows:

- Chapter 1: Nature and scope of the study – supplies an overview of the proposed study and introduces the background and context of the research;
- Chapter 2: Literature review – reviews the prior literature studies linked to inventory management and the challenge faced as well as adopting best practices;
- Chapter 3: Research design – describes the methodology used in this study; the measuring instruments that were used to gather data;

- Chapter 4: Conclusion and recommendations – summarises the research findings and provides conclusions as well as recommendations to the research study;
- List of references; and
- Annexures.

2 CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter contains a review of the relevant literature pertaining to inventory management practices and operational performance. It includes various definitions, characteristics, advantages, and disadvantages of the two main variables: inventory management practices and operational performance.

2.2 Inventory

Inventory is a resource of any kind that has an economic value (Ogbo and Ukpere, 2014:110). Basically, inventory refers to stock of anything necessary to do business. Inventory consists of materials that flow from suppliers through a manufacturing organisation to the customer. The different stages of material are classified as raw material, semi-finished goods, finished goods, and WIP (Panigrahi, 2013:108), which may be defined as follows:

- Raw materials – purchased or extracted materials that are transformed through the manufacturing process into components and/or products;
- Semi-finished goods – incomplete items requiring additional operations that will transform them into finished goods as applications or specifications may differ from one item to another;
- Finished goods – products sold as complete items; subject to customer orders or sales forecasts; and
- WIP – products in various stages of completion throughout the manufacturing process.

Inventory may be regarded as ingredients in the production of goods, ingredients such as finished goods, WIP, and/or raw materials; all of which account for a large percentage of the total assets invested in working capital in many organisations (Ogbo and Ukpere, 2014:3). Raw material, semi-finished goods, WIP and finished goods are all inventory components that represent the stock of a company. This stock contributes to the manufacturing process at various stages to complete products. Inventory represents one of the highest costs in manufacturing firms and can be defined as the stock purchased with the objective to resell in order to gain profits (Panigrahi, 2013:108). For the purposes of this study, the supply of raw material, semi-finished goods, finished goods, and WIP is the function of inventory that helps maintain an organisation's operational needs (Angel, Gomathi and Chitra, 2014:94). Inventory in production firms refers to the combination of materials held for sales, namely: items to be sold during the course of business, WIP for such sales, and items currently consumed in the production of goods or services to be available for resale (Morufu and Olayimika, 2016:117).

Inventory ensures uninterrupted production; the need thereof is seen as important in the field of manufacturing for the following reasons (Bose, 2010:4):

- Inventory is kept to meet future consumption;
- Inventory acts as a precaution against long lead times and/or consumption rate increases; and
- Inventory guards against price fluctuations and/or costs of materials over a period.

According to Onkundi and Bichanga (2016:159), inventories are an essential part of business because of their necessity in production, efficiency, and customer satisfaction. Stephenson (1996, cited in Onkundi and Bichanga, 2016:159) suggests that it is not uncommon for general organisations to invest in inventory of about 30 percent current assets and 90 percent working capital.

Greene (1997) commented that inventory relates to 'the movable articles of the business which are eventually expected to go into the flow of trade'. Every business needs an adequate quantity of inventory for efficient processing. However, this asset should be kept at the minimum possible level excess inventory involves additional holding costs, thus reducing profits (Panigrahi, 2013:108). Deveshwar and Modi (2013:1) define inventory as any stock that a company keeps to meet production and sales requirements and further suggest that the basic reason for holding inventory is to keep production activities unhampered. Therefore, keeping adequate inventory and managing it effectively is key to easing operations. Figure 2.1 highlights the points that stand out with reference to inventory.

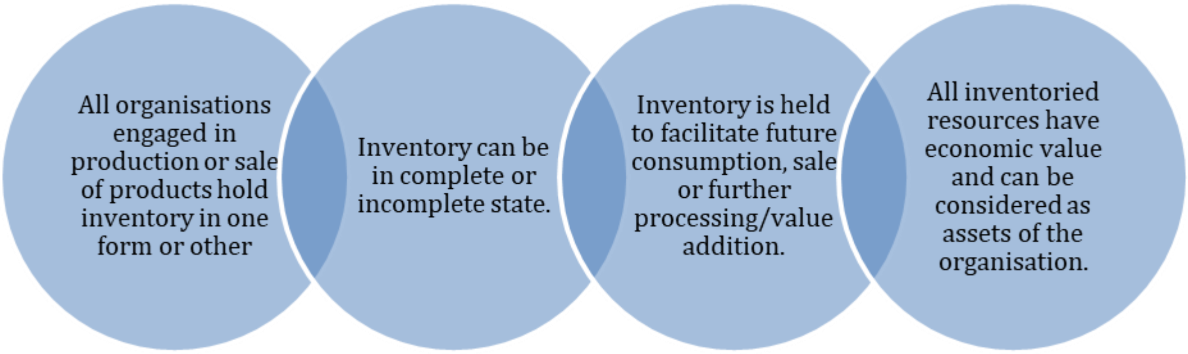

Figure 2-1: Key points with reference to inventory

Source: Adopted from (Anon, 2020)

2.2.1 *Types of inventory*

Inventories can be further classified according to the purpose they serve relevant to manufacturing firms as indicated in Figure 2.2 and further described in the sections that follow.

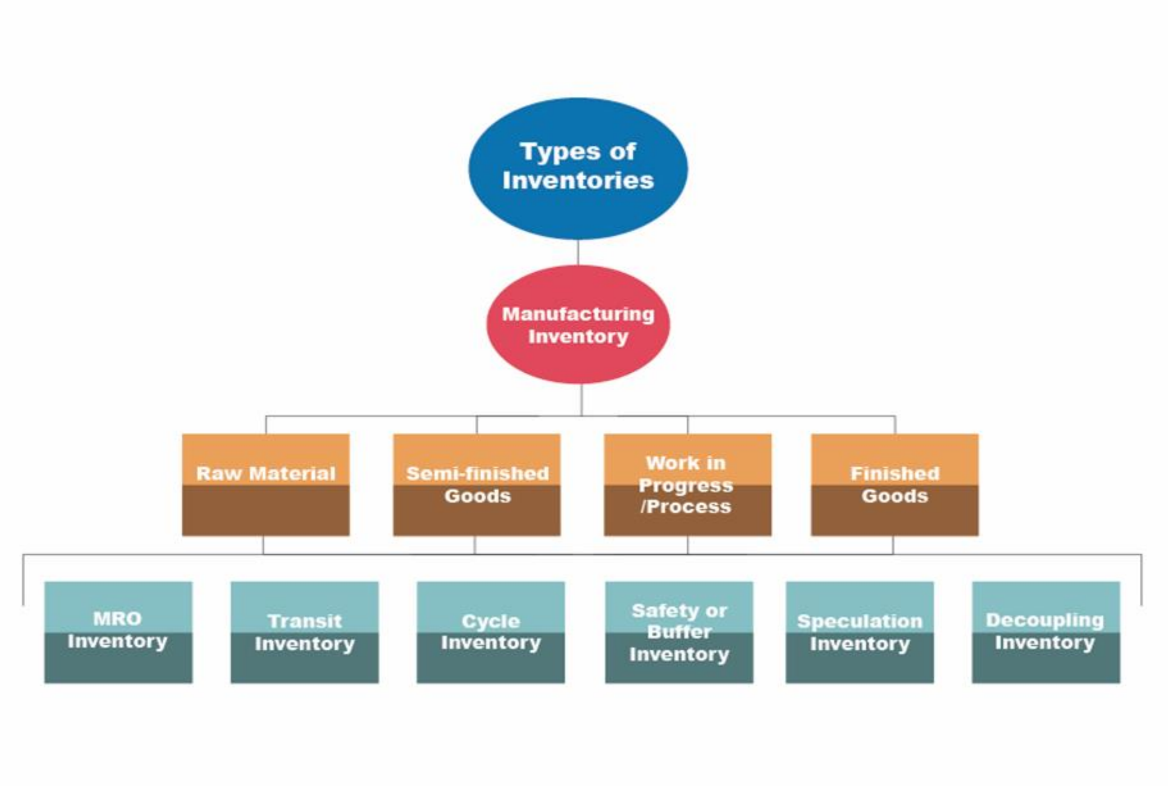

Figure 2-2: Types of inventory

Source: Adopted from (Ivanov, Tsipoulanidis and Schönberger, 2019)

2.2.1.1 Maintenance, repair, and operational inventory

Maintenance, repair, and operational (MRO) inventory does not become part of the product but is consumed in production to support and maintain the process. Examples of MRO inventory include oils, lubricants, tools, nuts, bolts, and even stationery such as paper, pens, and staples (Ivanov, Tsipoulanidis and Schönberger, 2019:346).

2.2.1.2 Transit inventory

Transit inventory consists of inventory that needs to be transported from one location to another. This type of inventory is not available for sale and/or shipment until after arrival and may be considered a part of cycle inventory (Hanson, Ackah and Agboyi, 2015:88).

2.2.1.3 *Cycle inventory*

Cycle inventory consists of inventories used for satisfying the usual/predicted demand between replenishments, which is also held to balance the holding and ordering costs to minimise the total cost. These inventories are ordered in batches, usually in lot sizes that are larger than demand. Batch order is preferred by many firms as there are associated savings benefits (Hanson, Ackah and Agboyi, 2015:88).

2.2.1.4 *Safety or buffer inventory*

Safety or buffer inventory is held in excess to protect against the uncertainties of supply and demand or lead time, as well as poor delivery reliability from suppliers. It is any amount of inventory held on hand that is more than what is currently needed (Hanson, Ackah and Agboyi, 2015:88).

2.2.1.5 *Speculation inventory*

Speculation inventory is purchased in excess of a firm's current demand in anticipation of price hikes or labour strikes. For manufacturing firms, speculation inventory helps build up inventory when demand is low to gear them for when demand is increased. This means inventory will be absorbed slowly and production time does not need to be increased, reducing excessive overtime and smoothing peaks in demand (Hanson, Ackah and Agboyi, 2015:88).

2.2.1.6 *Decoupling inventory*

Decoupling inventories are positioned between manufacturing process stages so that the inventory associated with one stage of a process does not slow down other parts of the process. This type of inventory serves as a shock absorber, protecting the system against production irregularities and utilising the facility (Shenoy and Rosas, 2018:5).

2.3 Motivation for holding inventory

Organisations generally hold more inventory than what they really want. Holding inventory makes it more economical to produce its products than by not holding it (Hanson, Ackah and Agboyi, 2015:87). The sections that follow describe the various reasons for holding inventory in more detail.

2.3.1 Demand

Demand for different products is unknown. Variations in sales, estimates, orders, and stocking patterns keep changing, in turn, resulting in production schedules changing. Hence, the need for holding inventory to absorb these variations (Hanson, Ackah and Agboyi, 2015:87).

2.3.2 Economies of scale

Organisations take advantage of price-quantity discounts when large quantities of goods are purchased. This results in excess inventory, which can be justified if the discount is enough to offset the extra holding cost incurred. Buying in larger lots and holding inventory is often cheaper than buying smaller lots more frequently as it involves less labour, phone calls, typing, and shipping, all of which accumulates to a lower per-unit cost (Hanson, Ackah and Agboyi, 2015:87).

2.3.3 Safety stock

Additional inventory (safety stock) is kept to provide a safeguard when demand increases or the lead time is longer than usual. Safety stock acts as a safety precaution to keep operations running when demand and lead times are unknown (Hanson, Ackah and Agboyi, 2015:87).

2.3.4 Protection from uncertainties

As a precaution against uncertainties, stock is sometimes accumulated in the expectation of rising prices or supply uncertainty in the market. It also acts as a buffer against events such as strikes, fires, and disruptions in supply (Hanson, Ackah and Agboyi, 2015:87).

2.4 Advantages and disadvantages of keeping inventory

According to Badenhorst-Weiss *et al*. (2018:196), the advantages of keeping inventory include:

- Prevention of stock outs and operational delays;
- Reduction in the risk of shortages;
- Giving customers assurance of availability;
- Guarding against scarcity of materials; and
- Protection against natural disasters and/or strikes.

The disadvantages of keeping inventory include (Gartenstein and Thompson, 2019):

- Unnecessary consumption of capital resources that could have been put to better use elsewhere in the firm;

- Masking quality issues that could have been resolved with less stock;
- Narrow-minded thinking due to loss of attention to careful planning and control of the supply and distribution channels;
- Increased storage and insurance costs; and
- Deterioration of goods.

2.5 Inventory management

The concept of inventory management has attracted different opinions in academic research. To gain insight into inventory management, it is important to have different views on the subject. Inventory management is responsible for the control of materials and goods that need to be available to an organisation when it is required to meet demand (Naliaka and Namusonge, 2015:88). Aro-Gordon and Gupte (2016:2) referred to inventory management as the tool for optimal use of resources and for achieving operational efficiency. Inventory management supervises the supply, storage, and accessibility of goods so that goods are not overstocked Aro-Gordon and Gupte (2016:2). Inventory management involves determining the total activities required to manage inventory, which include carrying costs, valuation, available space, forecasting, quality, defective goods and demand forecasting (Naliaka and Namusonge, 2015:88).

Angel, Gomathi and Chitra (2014:95) pointed out that inventory management is the process that aims to minimise the investment in inventory while balancing supply and demand through continuous planning, organizing, and controlling. According to Munyao *et al.* (2015:1627), inventory management is best explained as the integration of information, transportation, acquisition, inspection, material handling, warehousing, packaging, and control of supplies, which basically represents all activities of planning, forecasting, and replenishment for inventory.

2.6 Inventory management: conflicting objectives

All organisations strive for a high level of customer service, operating efficiently, and minimizing inventory cost. However, these objectives are often in conflict (Wirtz and Zeithaml, 2017:60-61). To better explain this dilemma, it is of value to explain these concepts in more detail:

- Customer service – the ability to deliver a product or service to the customer (i.e. purchaser, distributor, another plant, or the next workstation in the organisation) at the desired time. The effectiveness of inventory management is measured by customer service, and the percentage of orders, line items, and order-days out of stock are shipped on the schedule are ways to keep track of the effectiveness. Inventory helps with servicing of the different processes, protecting against production fluctuations, but at higher inventory cost (Wirtz and Zeithaml, 2017:60-61);

- Operating efficiency – the ratio of actual work output to the scheduled planned output. Inventory plays a vital role in the different production levels, as it allows longer production runs, which is more economical. Operating efficiency can allow for larger order quantities, which can reduce setup costs, ordering costs, and allow for better costing from suppliers (Wirtz and Zeithaml, 2017:60-61); and
- Inventory cost – the tangible and intangible costs that contribute to the enhancement of customer service and operating efficiency. These costs are not free and have the cost implication of carrying, capacity, and ordering costs as well as deteriorating inventories as a result of stockpiling (Wirtz and Zeithaml, 2017:60-61).

The different departments within a company are likely to have different objectives relating to the above concepts. For example: the purchasing manager would like to order larger batches in order to get better discounts. The production manager prefers a large raw material inventory to avoid delays in the production process. The finance manager prefers minimum inventory on hand because it ties up unnecessary capital resources that could have been put to better use elsewhere in the firm.

2.7 Inventory control

Inventory control is a set of policies and procedures designed to maximise a company's use of inventory as it is one of the largest assets of the business that helps generate profits (Silver, Pyke and Thomas, 2016).

Inventory control is the process that monitors the day-to-day activities in which materials and parts are kept in stock, flowing through the regulated pre-determined destination in accordance with the policies and procedures implemented by the organisation (Monczka, Handfield, Giunipero and Patterson, 2019:175-176). Inventory control can also be described as managing the activity performed to ensure that the correct material and quantity is available at the right place and time as it is directly connected with production (Kwadwo, 2016:22-26).

Naliaka and Namusonge (2015: 87-104) argued that inventory control deals with the problems of verifying the quantity and value and balancing of the entire stock holding so that it enables the material manager to report accurately and carry out efficient operation of the manufacturing organisation. In addition, it allows the material manager to assess the status of the stock, to tell how much was ordered, how many were used, what is the balance left, and how much the organisation still requires at any point in time.

According to Silver, Pyke and Thomas (2016) a good inventory control system:

- limits inventory holding;
- updates inventory policies when new challenges are encountered;
- provides an overview of financial implications;
- regulates individual and collective requirements;
- reduces the delays in production; and
- organizes the availability of items to the customers.

Several techniques/concepts/models that could be adopted to ensure the above activities are in place and working to assist organisations with their inventory control:

- the economic order quantity model;
- ABC analysis;
- the ‘just in time’ technique;
- the max-min system; and
- the periodic review system.

2.7.1 Economic order quantity

The economic order quantity (EOQ) model aims at minimising an organisation's ordering and holding costs by supplying the optimal quantity that is required for the activities in an organisation when stock needs to be replenished. Furthermore, the EOQ model continuously reviews the inventory system, where the level of inventory is always monitored and a fixed quantity is ordered when the inventory level is reached (Oballah, Waiganjo and Wachiuri, 2015). However, the model assumes all variables are constant, so if uncertainties occur like changes in demand, damage during transit or delay in delivery, it will force the EOQ model to adjust to an uncertain business environment.

2.7.2 ABC analysis

ABC analysis the process of dividing inventories into categories or classification according to value, namely: 'A' being the higher value items, 'B' as next most valuable items, and 'C' being the lowest valued items. The ABC analysis aims to draw attention to the critical few and not to the trivial many, focusing effort according to value and importance where result could be maximised (Hoque, Biswas and Wazed, 2015:11).

2.7.3 The 'just in time' technique

Just in time (JIT) is defined as a production scheduling and inventory control technique that ensures just enough material is available at the time it is required, which helps reduce cost by avoiding excess inventories and its associated costs (Munyao *et al*., 2015).

2.7.4 The max-min system

The max-min system consists of two parts, namely; a maximum amount of inventory and a minimum amount. This means when stock reaches a critical level, an alert will occur to replenish the stock, which implies that the replenishment of certain items will be realised at different stages, ensuring 100 percent stock availability and reducing the possibility of stock-outs. However, it is not possible to order more than the maximum amount (Apsalons and Gromov, 2017:80).

2.7.5 The periodic review system

The periodic review system refers to performing stock-take on a periodic basis, by reviewing the stock-level in a fixed period, such as every three months or once a year when requirements of all items are determined (Gbadomosi, 2013).

2.8 Manufacturing

Manufacturing can be defined as a value-added production of merchandise as it involves making products from raw material by using various processes and making use of hand tools, machinery or even computers (Singh, 2006).

2.9 Operational performance

The term operations can be defined as the processes and resources that an organisation uses to transform various activities into desired goods, services and create value to the customers (Stevenson, 2015). Waruiru and Kagiri (2013) describe performance as the output results from processes, products and services that is measured against standards, goals, past results and other organisations. Operational performance is thus defined as the strategic dimension of competing firms to fulfil goals and objectives which are measured against standard or prescribed indicators of effectiveness, efficiency, and environmental responsibility such as, cycle time, productivity, waste reduction, and regulatory compliance as well as flexibility and delivery (Mwichigi and Waiganjo, 2014).

2.10 Relationships between inventory management and operational performance

This topic will be discussed using the results of previous studies and researchers' findings to identify the relationship between inventory management and operational performance. The studies concluded the following:

- Poor inventory management can present a serious challenge to the productive capacity of a manufacturing firm (Unyimadu, 2014);
- By following effective inventory management practices business performance can be enhanced (Nyabwanga and Ojera, 2012);
- An increased operational efficiency, lower institutional and operational costs, shorter leads-times and reduced inventory all form part of the benefits related to the adoption of inventory management (Cagliano, DeMarco, Rafele and Volpe, 2011);
- Reduced inventories and timely replenishment of inventory to user departments influenced operational performance (Otundo and Bichanga, 2015);
- Inventory management practices positively affected productivity, reduced cost and decreased inventory holdings of large manufacturing firms in Narobi, Kenya (Ngumi, 2015);
- Proper material codification and storage procedures correlate positively and significantly with performance (Wauna and Obwogi, 2015);
- Holding stock and ordering costs may increase the performance of an organisation, and an inventory control system, organisational development, information sharing, and channelled relationships affect the performance of the manufacturing firms (Kimaiyo and Ochiri, 2014);
- A strong and positive relationship between inventory management systems and organisational performance with three variables: inventory speed, inventory cost, and inventory accountability, is strongly and positively related to organisational performance (Jefwa and Owuor, 2015); and
- Inventory management is positively correlated with the firm’s performance (Sahari and Norlina, 2012).

The review of studies by various authors confirmed that there is a positive and strong relationship between inventory management and operational performance. In addition, the level of investment in inventory management will assist organisations in maintaining optimal levels of inventory as well as assist with estimating, controlling and tracking of inventory to ensure a positive influence on operational performance.

3 CHAPTER 3: EMPIRICAL RESEARCH

3.1 Introduction

The objective of this study was to analyse the effect of inventory management on operational performance in a manufacturing environment. The previous chapters involved an introduction and literature review relevant to the process involved within the organisation. This chapter discusses the research method and describes the design with the view to achieve the stated objectives of this research work.

3.2 Research methodology

According to Saunders, Lewis and Thornhill (2019), research methodology is the specific procedure used to gather and analyse data about a topic. It allows the reader to critically evaluate a study's overall validity and reliability. This study was based on a quantitative research method approach.

3.2.1 Research design

This study adopted a cross-sectional approach to analyse the effect of inventory management on operational performance in a manufacturing environment. The design was appropriate for this study as cross-sectional studies involve analysing at data from a group of people at one specific point in time and describes what is happening at that present moment (Setia, 2016).

In this study a research questionnaire with four sections (largely based on a 6-point Likert scale) was created and distributed to the target population. A permission letter was obtained from '123 Africa' to conduct research in various departments within their organisation. as well as a consent form from participants taking part in the survey. Once the data was collected, it was captured by the NWU Statistical Consulting Services to determine if the data was valid or reliable. The outcome of the results made it possible to interpret and draw a conclusion.

3.2.1.1 Population

3.2.1.1.1 Sampling

The target population consisted of 100 employees from '123 Africa' within the various departments within their organisation that support the manufacturing activities. These activities include design, planning, distribution and fabrication, all of which support the manufacturing process.

Due to the significant sampling size of the quantitative analysis, this study made use of probability sampling (Maree, 2016). Probability sampling draws randomly from a wider population. The probability sampling used in the research is simple random sampling. With simple random sampling, it supplies all members with an equal chance of being selected, without any involvement from other individuals, each participant chosen is entirely independent (Cohen, Manion and Morrison, 2017).

Various departments within the organisation were involved in the research process:

- Operation;
- Engineering;
- Quality;
- Marketing and sales;
- Fabrication;
- Maintenance;
- Planning;
- Stores and warehousing;
- Procurement; and
- Finance.

3.2.1.2 Measuring instrument

The study made use of a survey type questionnaire with four sections largely based on6-point Likert scale questions, as well as some open-ended questions distributed to the target population (see Appendix B). A permission letter was obtained from '123 Africa' to conduct research in various departments within their organisation, and a consent form from participants taking part in the survey was obtained. The answering of the questionnaire was completely voluntary. The questionnaire was structured in such a way not only to supply the researcher with patterns but also to allow the researcher to observe comparisons across the sampling group (Cohen, Manion and Morrison, 2002). NWU Statistical Consulting Services assisted with the data analysis. The questionnaire was divided into four sections, namely:

3.2.1.2.1 Section 1: respondent and business profile

Section 1 of the questionnaire gathered personal information of the participants that covered department of employment, level of management, years of service, level of education and how many employees within the selected organisation. This section aimed to gather general demographic information of the participants to provide some basic background information.

3.2.1.2.2 Section 2: inventory (stock management practices)

Section 2 was a multidimensional variable adapted to measure inventory management practices. This section collected information on the process of acquiring, distributing and storing inventory within the organisation.

3.2.1.2.3 Section 3: Challenges faced when managing inventory

Section 3 assessed the operational performance and the challenges faced with managing inventory.

3.2.1.2.4 Section 4: Crisis management practices

Section 4 was put in place to have an overview of the organisation's crisis management practices. It consisted mostly of open-ended questions and gave the respondents the opportunity to highlight areas where the organisation might be at risk in their view.

The questionnaire consisted largely of six-point modified Likert scale type questions to elicit responses and was adopted from combination of sources to meet the needs of the study. The scales used in this questionnaire were expected to increase the reliability of the responses (Sin, and Tse, 2002). Furthermore, it was also expected to increase the spread of variance of feedbacks (Aaker, Kumar, George, 2000).

3.2.1.3 Ethical considerations

Considering that the proposed study involved human participants, ethical guidelines needed to be followed in the conducting of this research. Specific code of ethics is set which researches and other different professions follow an overall system of conduct to comply with when it comes to research. Fulfilling the requirements, the following needed to be taken into consideration:

- Confidentiality to provide protection for participants;
- Serving interests of groups, individuals, or society in its entirety; and
- Managing risks by making use of informed consent.

Participants were thoroughly briefed before the research commenced and made aware that the research was voluntary and that the participants had the right to withdraw at any time. The participants were required to tick a box to say that they had read and understood the contents of the informed consent statement and gave full consent by providing a tick in the box provided. This formed evidence that the participation in the study was voluntary and not forced. Furthermore, the identity of the participants and the organisations were kept confidential.

All participants remained confidential and the researcher was honest in processing the data and the interpretation thereof. The research findings were maintained objectively, and the researcher used the research results for academic purposes only.

3.2.1.4 Data collection

In collecting primary data, the researcher used the survey method of research using questionnaires. Questionnaires are a structured data collection technique whereby participants were asked the same set of questions for the purpose of the research study (Morris, 2001). The study used mostly closed-ended questions to utilise and enable accurate capture of data from the staff of the manufacturing organisation (Mwangangi *et al*., 2015). The quantitative research instrument was also used to collect demographic data of the staff in the organisation as well as data on inventory management practices and operational performance.

3.2.1.5 Data analysis

The data collected in this research was quantitative in nature. Completed questionnaires were sent to the NWU Statistical Consulting Services to aid in capturing and statistical analysis of the data.

3.3 Research findings

3.3.1 Data validity and reliability

Validity refers to the degree to which the content is believable of the findings that will be established by the researcher. It determines how accurate the research was to that which it was intended to measure (Krishnaswamy, Sivakumar and Mathirajan 2009).

Reliability is described as the consistency of the result, regardless of who the administers are over time (Newstrom, 2011). Meaning that if the measurement must be repeated with the same results, then the research instrument is considered to be reliable. Reliability measures if a questionnaire and its underlying constructs are consistently reflecting what it is measuring, this means that:

- a person completing the questionnaire on two different points in time should get the same score for each of the constructs each time they complete the questionnaire, all other things being equal; and
- two people who are the same in terms of the constructs being measured by the questionnaire should both get the same scores for these constructs.

To test the reliability of the survey, a Cronbach's alpha test was used to measure the consistency. Cronbach's alpha is a coefficient that describes how well a group of items focuses on a single idea or construct (Cronbach, 1951). According to Taber (2017), this test consists of an alpha coefficient with a value between 0 and 1. Values of 0.6 or above indicate that the questions combined in the scale are measuring the same thing. This test yields a more conservative estimate of reliability than other tests: the estimated coefficient of reliability of data is always lower. A higher coefficient implies that items correlate highly amongst themselves indicating a high level of consistency among the items being measured. The reliability test is presented in table 3-1 below:

Table 3-1: Cronbach's Alpha

Construct	Questions no.	Questions	Cronbach's Alpha	Mean	SD
Inventory management practices	Sec2 Q1,6a - 1,6j	To what extent do you agree with the following statements about how your business orders inventory (stock)?	0.666	2.89	0.52
Inventory control	Sec2 Q1,14a - 1,14j	To what extent do you agree with the following statements about inventory (stock) control by your company's staff in the warehouse (stores)?	0.640	3.66	0.29
Need for warehouse	Sec2 Q1,15a-Q1,15f	To what extent do you agree with the following statements about the need for a warehouse in your company?	0.683	2.28	0.65
Challenges with regards to managing stock	Sec3 Q1,16a - Q1,16n	How often do you experience the following challenges in your business?	0.855	2.51	0.54

All the reported Cronbach Alpha values were above the guideline value of at least 0.6 (in the early stages of research) which indicate that they are reliable. The means of the resulting factors ranged between 2.28 (SD = 0.65) and 3.66 (SD = 0.29) indicating that the averages responses ranged between disagreeing and agreeing. It is important to note that 'Sec3 Q1,16a - Q1,16n' had a five-point Likert scale and according to Vaske, Beaman and Sponarski (2016), a six-point Likert scale will have a different alpha value for the same questions as a five-point scale, and that is why you accept values above 0.6 in this study.

3.3.2 Response rate

The target population of this study was affected as explained in the limitation of the study. Due to the identified limitation of the study, a target sample of 100 respondents was set. To achieve this target, 100 questionnaires were distributed to different departments within the selected organisation.

Table 3-2: Response rate

Statement	Number of respondents	Percentage
Questionnaires distributed	100	100.00%
Questionnaires not returned	28	28.00%
Questionnaires returned	72	72.00%

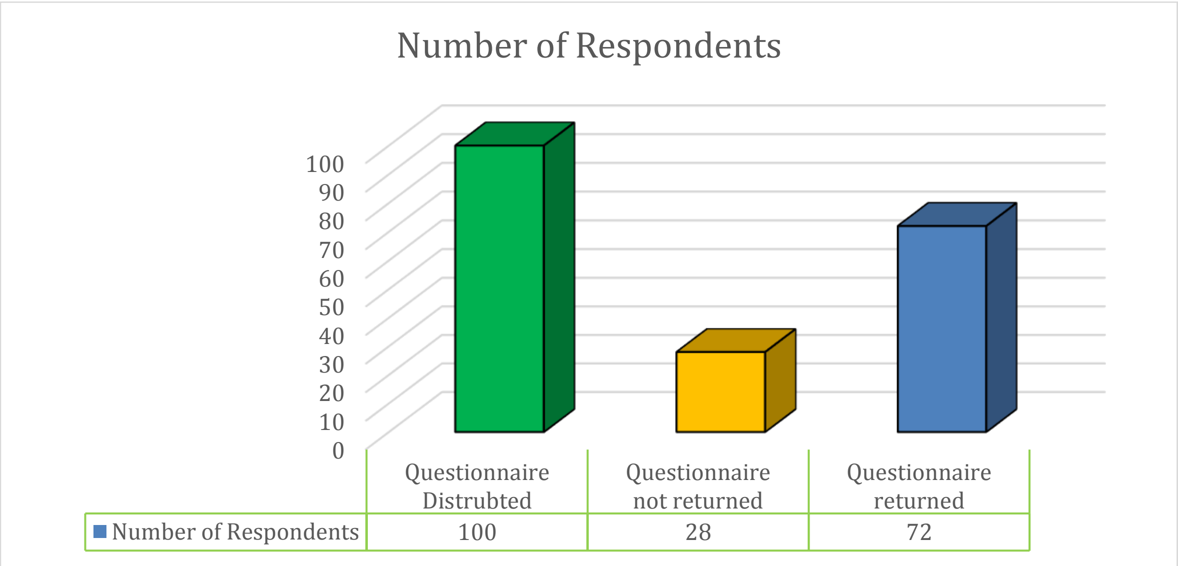

Figure 3-1: Response rate

Of the questionnaires distributed, only 72 were usable and 28 respondents declined to participate in the study. Thus, the response rate of 72% was achieved. As seen in the detail in Table 3-2 and

Figure 3-1. According to Fincham (2008) a response rate of approximately 60% for most research should be the goal of the researcher.

3.3.3 Section 1: Frequencies – demographic information

The results in this section were captured and reported in a descriptive statistic form. The result of each question was displayed by making use of bar charts, pie charts and tables. The main percentage investigated was the valid percent rate, as this refers to respondents who participated. The respondents who did not respond, were captured as missing as Flom (2017) suggested that only respondents that responded could be used.

3.3.3.1 *Frequency analysis: department of employment*

The detail in Table 3-3 and Figure 3-2 provides information as to which department the respondents belong. The results indicated that just over one-third of the respondents were employed at operations (34.3%), the second most at quality (18.6%), third most at engineering (11.1%) and the remainder were spread between the other departments.

Table 3-3: Frequency analysis – department of employment

Q1	Department of Employment	
Departments	Frequency	Valid Percent
1 - Operations	24	34.3
2 - Engineering	8	11.4
3 - Quality	4	5.7
4 - Marketing and Sales	13	18.6
5 - Fabrication	5	7.1
6 - Maintenance	6	8.6
7 - Planning	2	2.9
8 - Stores and Warehousing	2	2.9
9 - Procurement	1	1.4
10 - Finance	3	4.3
11 - Other	2	2.9
Total	70	100.0
Missing Data	2	
Total	72	

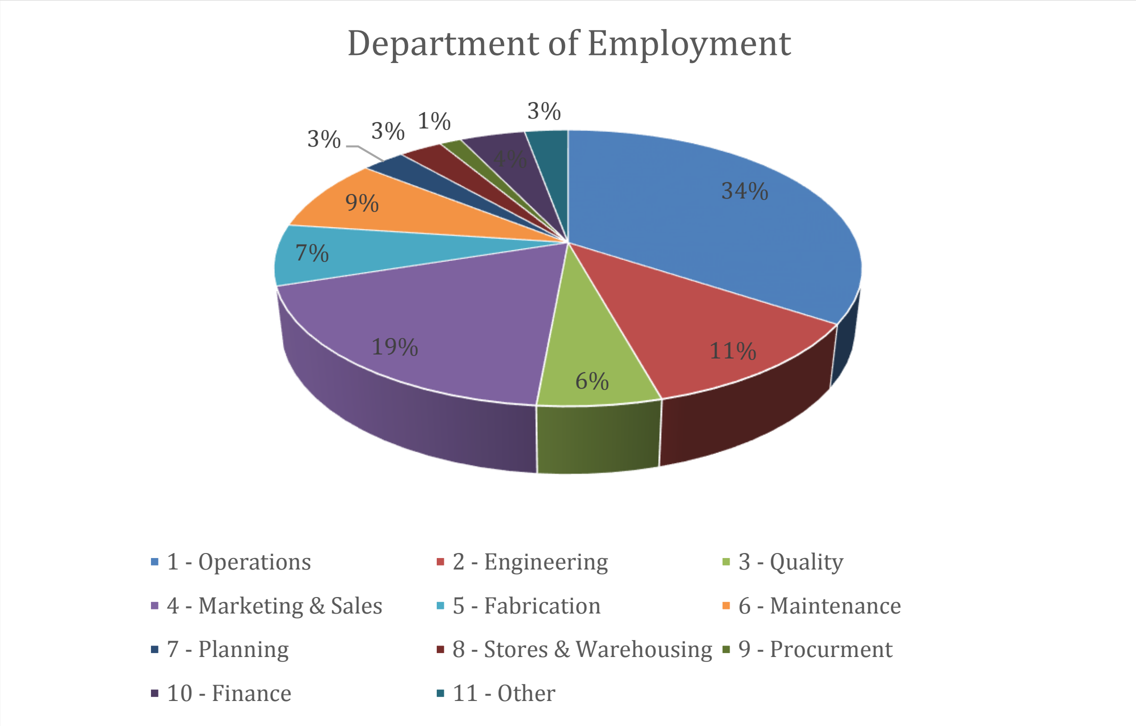

Figure 3-2: Frequency analysis – department of employment

3.3.3.2 Frequency analysis: level of management

The results indicated that ten (14.1%) of the respondents were at a supervisory level of management, 23.9% of the sample was at middle management level, and 7% were at senior management level. None of the respondents indicated that they were directors (0%). 33.8% were operators, and 21.1% selected other.

Table 3-4: Frequency analysis – level of management

Q2	Level of Management	
Management Level	Frequency	Valid Percent
1 - Supervisor	10	14.1
2 - Middle Management	17	23.9
3 - Senior Management	5	7.0
5 - Operator	24	33.8
6 - Other	15	21.1
Total	71	100.0
Missing Data	1	
Total	72	

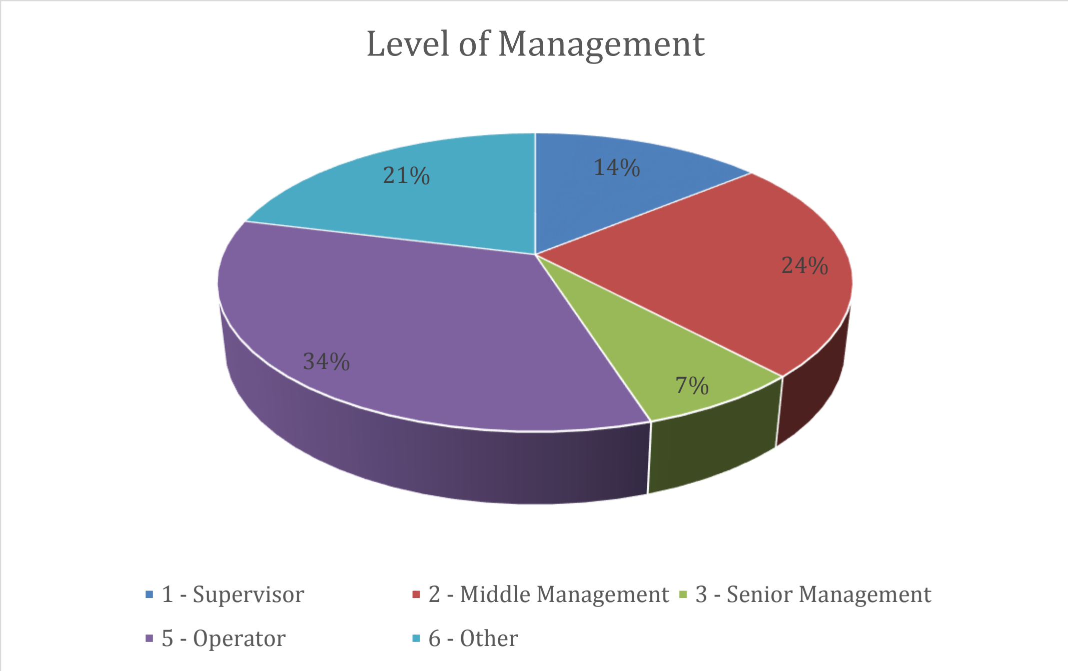

Figure 3-3: Frequency analysis – level of management

3.3.3.3 Frequency analysis: level of experience

The number of years worked was recorded as follows: 33.3% of the respondents indicated that they had worked 0-3 years, 45.3% of the sample had 4-10 years' experience and 16.7% had 11-15 years. Lastly 4.2% respondents indicated that they had 16-20 years' experience. The largest sample was the 4-10 years category.

Table 3-5: Frequency analysis – level of experience

Q3	Level of Experience	
Level of Experience	Frequency	Valid Percent
1: 0-3 years	24	33.3
2: 4-10 years	33	45.8
3: 11-15 years	12	16.7
4: 16-20 years	3	4.2
Total	72	100.0

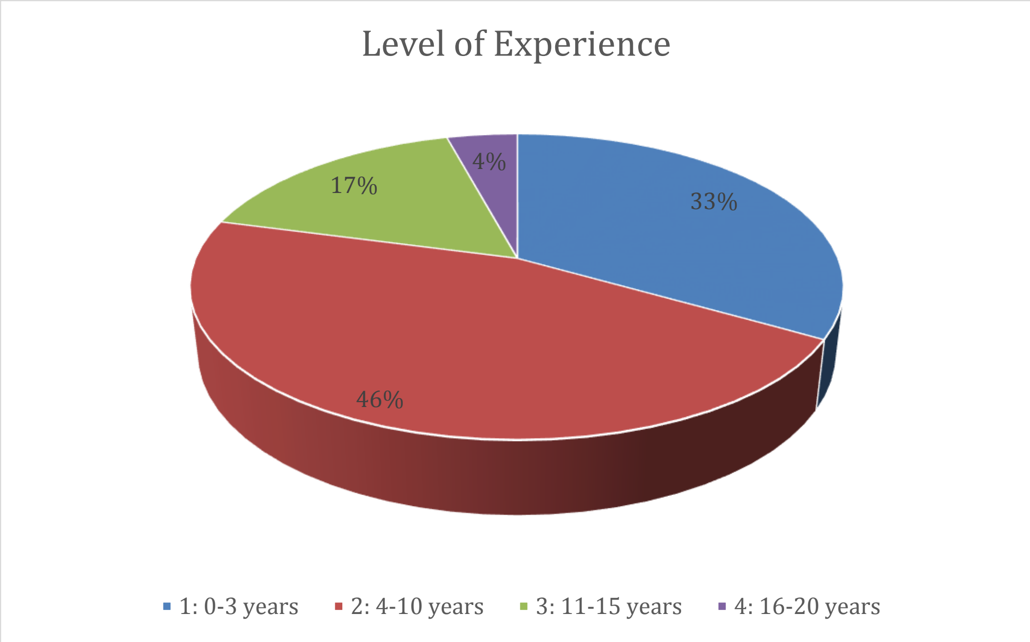

Figure 3-4: Frequency analysis – level of experience

3.3.3.4 Frequency analysis: level of education

The analysis of the level of education results indicated that 55.6% of the respondents had a diploma certificate; 13.9% of the sample had no formal qualification but had received fabrication experience (on the job training), while 6.9% had a bachelor's degree qualification. None of the respondents indicated that they had a doctorate (0%). Only 2.8% of the respondents had a master's degree and 20.8% selected other. Therefore, most of the respondents (55.6%) had some form of formal education and were likely able to answer the questions competently.

Table 3-6: Frequency analysis – level of education

Q4	Level of Education	
Level of Education	Frequency	Valid Percent
1 - Diploma	40	55.6
2 – Fabrication experience (on the job training)	10	13.9
3 - Bachelor's degree	5	6.9
4 - Master's degree	2	2.8
6 - Other	15	20.8
Total	72	100.0

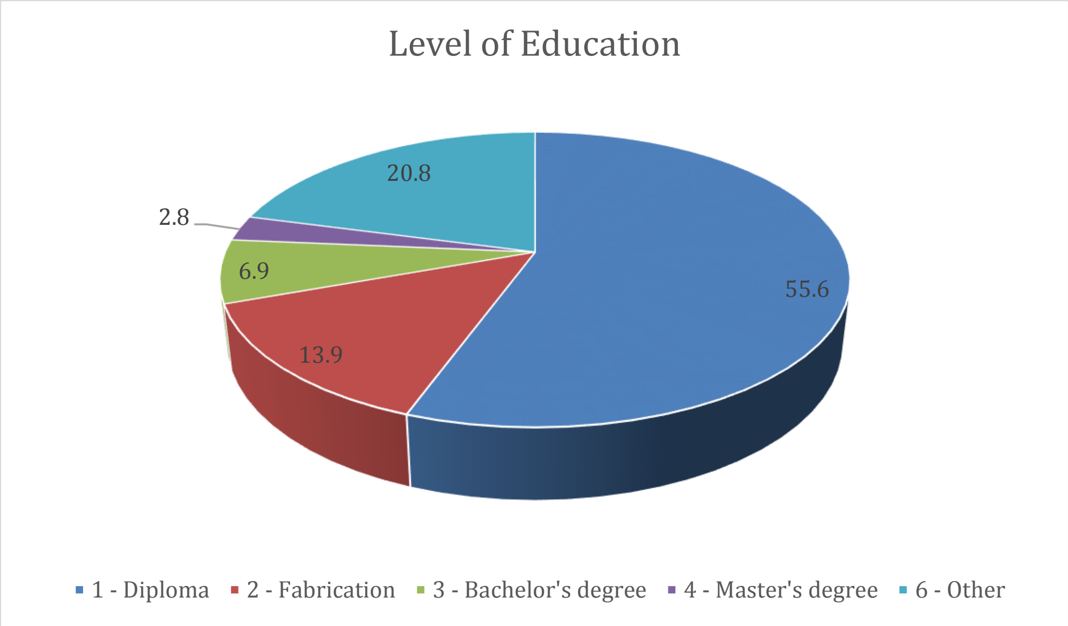

Figure 3-5: Frequency analysis – level of education

3.3.4 Section 2: Frequencies – inventory management practices

This part of section 2 contains responses to questions regarding inventory management practices, aimed at investigating the process of how the selected organisation manages inventory.

3.3.4.1 Frequency analysis: inventory management practices

The detail in Table 3-7 provides information to which extent the respondents agreed with the statement on how their organisation orders inventory. The results indicated that the highest mean was reported for the statement indicating that inventory (stock) is ordered when the company receives and enquiry from its customer (mean = 3,41; SD = 1,05) indicating that the respondents felt neutral but were inclined towards agreeing with the statement. The lowest mean was reported for the statement indicating that the company orders inventory (stock) automatically from its suppliers without even placing and order (mean = 1,83; SD = 0,91) indicating that the respondents disagreed with the statement.

Table 3-7: Frequency analysis – inventory management practices

No	Statement	n	% Don't know	% Strongly Disagree	% Disagree	% Neutral	% Agree	% Strongly Agree	Mean	Std. Dev
Q1. 6a	The company relies on common sense to determine the quantity of inventory (stock) to order	71	9.86	14.08	23.94	11.27	38.03	2.82	2.91	1.20
Q1, 6b	The company uses and equation to calculate the quantity of inventory (stock) to order	70	30.00	2.86	22.86	8.57	30.00	5.71	3.18	1.11
Q1, 6c	The company orders a fixed quantity of inventory (stock) periodically	71	11.27	7.04	47.89	1.41	29.58	2.82	2.70	1.12
Q1, 6d	The company orders inventory (stock) in bulk to take advantage of trade discounts	71	19.72	8.45	14.08	29.58	21.13	7.04	3.05	1.11
Q1, 6e	The company orders inventory (stock) when we receive an enquiry from our customer	71	9.86	5.63	15.49	11.27	52.11	5.63	3.41	1.05
Q1, 6f	The company receives our inventory (stock) automatically from our suppliers without even placing an order	71	11.27	33.80	45.07	4.23	2.82	2.82	1.83	0.91

No	Statement	n	% Don't know	% Strongly Disagree	% Disagree	% Neutral	% Agree	% Strongly Agree	Mean	Std. Dev
Q1, 6g	The company orders only when we run out of stock	71	5.63	21.13	26.76	28.17	12.68	5.63	2.52	1.16
Q1, 6h	When the company's inventory (stock) reaches a certain level, they automatically place an order	72	19.44	4.17	22.22	27.78	19.44	6.94	3.03	1.04
Q1, 6i	When the company places an order, they receive inventory (stock) without delay	71	23.94	8.45	29.58	15.49	16.90	5.63	2.76	1.15
Q1, 6j	The company orders most of their inventory (stock) from suppliers only within Gauteng province	71	18.31	16.90	19.72	4.23	39.44	1.41	2.86	1.28

Furthermore, as reported in above table 3-7, most respondents (52.11%) indicated that their organisation orders inventory (stock) when they receive an enquiry from their customer. While 39.44% respondents indicated that their organisation orders most of their inventory from suppliers only within the Gauteng province. Of the respondents, 38.03% indicated that their organisation relies on common sense to determine the quantity of inventory to order. Only 30% of the respondents reported that their organisation makes use of an equation to calculate the quantity of inventory to order, while 29.58% indicated that their organisation orders a fixed quantity of inventory periodically. 21.13% of the respondents indicated that their organisation orders inventory in bulk to take advantage of trade discounts. Among the least used practices were: when the organisation's inventory (stock) reaches a certain level, they automatically place an order (19.44%); when the organisation places an order, they receive inventory (stock) without delay (16.90%); ordering inventory only when they run out of stock (12.68%); and lastly the organisation receives inventory automatically from supplier without even placing an order (2.82%). Looking at the mean and standard deviation in Table 3-7, most of the respondents felt neutral but were inclined towards agreeing with the statement, excluding Q1.6 F where the respondents disagreed with the statement.

3.3.5 Section 2: Frequencies – inventory control

This part of section 2 contains responses to questions regarding inventory control, aimed at investigating the process of how employees from the selected organisation controls inventory.

3.3.5.1 Frequency analysis: inventory control

The detail in Table 3-8 provides information to which extent the respondents agreed with the statement on how their organisation controls inventory. The results indicated that the highest mean was reported for the statement indicating that the staff of the organisation uses computers to record inventory (stock) received (mean = 4.24; SD = 0.43) indicating that the respondents felt strongly about the statement and were in agreement. The lowest mean was reported for the statement indicating that the company's warehouse staff have access to their organisations accounting records (mean = 2.69; SD = 1.16) indicating that the respondents felt neutral but agreed to some extend with the statement. However, it is important to note that 50.7% of the respondents indicated that they were uncertain.

Table 3-8: Frequency analysis – inventory control

No	Statement	n	% Don't know	% Strongly Disagree	% Disagree	% Neutral	% Agree	% Strongly Agree	Mean	Std. Dev
Q1.14a	The company's warehouse staff verify delivery, receipt and storage of stock	72	1.39	0.00	0.00	2.78	81.94	13.89	4.11	0.40
Q1.14b	The company's warehouse staff have access to our accounting records	71	50.70	8.45	15.49	9.86	14.08	1.41	2.69	1.16
Q1.14c	Does your company have clear procedures followed by staff when receiving and issuing stock from our warehouse	72	4.17	0.00	1.39	4.17	69.44	20.83	4.14	0.55
Q1.14d	Access to the company's warehouse is restricted to authorized staff only	72	1.39	1.39	11.11	5.56	63.89	16.67	3.85	0.89
Q1.14e	The company's staff use computers to record inventory (stock) received	71	0.00	0.00	0.00	0.00	76.06	23.94	4.24	0.43
Q1.14f	The company's staff can determine inventory (stock) balance at any time	72	8.33	0.00	20.83	8.33	51.39	11.11	3.58	0.98
Q1.14g	The company's staff use a barcoding system to monitor movement of inventory (stock) in the warehouse	71	4.23	7.04	45.07	4.23	30.99	8.45	2.88	1.20
Q1.14h	Disposal of inventory (stock) must be authorized by senior staff	72	5.56	0.00	0.00	2.78	69.44	22.22	4.21	0.48

No	Statement	n	% Don't know	% Strongly Disagree	% Disagree	% Neutral	% Agree	% Strongly Agree	Mean	Std. Dev
Q1.14i	Purchase order copies are sent to the storekeeper to verify delivery made	72	16.67	1.39	20.83	6.94	41.67	12.50	3.52	1.08
Q1.14j	Anomaly in inventory (stock) delivered is reported to senior personnel	72	27.78	1.39	0.00	11.11	47.22	12.50	3.96	0.71

As summarised in the above table 3-8, 81.94% of the respondents agreed that their organisation's warehouse staff verify delivery, receipt and storage of stock. Of the respondents, 76.06% indicated that they use computers to record inventory received, while 69.44% indicated that the disposal of inventory must be authorised by senior staff. The same percentage (69.44%) of respondents confirmed that they have clear procedures followed by staff when it involves receiving and issuing stock from their warehouse. Of the respondents, 63.89% confirmed that access is restricted to the organisation's warehouse to authorized staff only. Of the respondents, 51.39% indicated that the organisation's staff can determine inventory balances at any time. Only 47.22% of the respondents indicated that if an anomaly arises when inventory is delivered it gets reported to senior personnel. Likewise, only 41.67% indicated that purchase order copies are sent to the storekeeper to verify deliveries made. Of the respondents, only 30.99% indicated that their organisation makes use of a barcoding system to monitor movement of inventory in the warehouse. The lowest percentage (14.08%) of respondents indicated that their warehouse staff has access to accounting records.

3.3.6 Section 2: Frequencies – need for warehouse

This part of section 2 contains responses to questions regarding the need for a warehouse in the selected organisation.

3.3.6.1 Frequency analysis – need for warehouse

The detail in Table 3-9 provides information to which extent the respondents agreed with the statement related to their organisations' need for a warehouse. The results indicated that the highest mean was reported for the statement indicating that the company is very small, so they store all their inventory within their premises (mean = 2,87; SD = 1,25), indicating that the respondents felt neutral but were inclined towards agreeing with the statement. The lowest mean was reported for the statement indicating that the company does not need a warehouse because they buy from suppliers and deliver straight to customers (mean = 1,86; SD = 0,93) indicating that the respondents disagreed with the statement.

Table 3-9: Frequency analysis – need for warehouse

No	Statement	n	% Don't know	% Strongly Disagree	% Disagree	% Neutral	% Agree	% Strongly Agree	Mean	Std. Dev
Q1.15 a	The company does not need a warehouse because they buy from suppliers and deliver straight to customers	72	1.39	36.11	51.39	2.78	5.56	2.78	1.86	0.93
Q1.15 b	The company does not need a warehouse because they only order an item when a customer order from them	72	2.78	31.94	54.17	1.39	8.33	1.39	1.90	0.90
Q1.15 c	The company is very small, so they store all their inventory (stock) within their premises	70	0.00	18.57	25.71	8.57	44.29	2.86	2.87	1.25
Q1.15 d	The company does not pile up slow moving stock which requires a warehouse	72	12.50	6.94	43.06	11.11	23.61	2.78	2.68	1.06
Q1.15 e	The company deals in perishable goods that cannot be stored in warehouse	71	9.86	21.13	42.25	15.49	9.86	1.41	2.20	0.98

No	Statement	n	% Don't know	% Strongly Disagree	% Disagree	% Neutral	% Agree	% Strongly Agree	Mean	Std. Dev
Q1.15f	The company need a warehouse but cannot afford one	72	1.39	25.00	54.17	9.72	8.33	1.39	2.06	0.91

As summarised in above table 3-9, 44.29% of the respondents agreed that their company is very small, so they store all their inventory (stock) within their premises. This could also mean that the company's premises are large enough to keep all their inventory on site. Of the respondents, 23.61% indicated that their company does not pile up slow moving stock which requires a warehouse. Only 9.86% of the respondents indicated that their company deals in perishable goods that cannot be stored in a warehouse, while 8.33% of the respondents indicated that their company needs a warehouse but cannot afford one. The same percentage (8.33%) of the respondents indicated that their company does not need a warehouse because they only order an item when a customer places an order. The lowest percentage (5.56%) of respondents indicated that their company does not need a warehouse because they buy from suppliers and deliver straight to their customers.

3.3.7 Section 3: Frequencies – challenges faced when managing stock

Section 3 contains responses to questions regarding inventory related challenges in the selected organisation.

3.3.7.1 Frequency analysis: challenges faced when managing stock

The detail in Table 3-10 provides information to which extent the respondents experienced inventory related challenges. This Likert scale used differs from the others previously encountered within the above sections. Firstly, the question contained a five-point Likert scale made up of the following options: never, rarely, sometimes, often and almost always. To achieve clarity and conciseness, percentages of respondents who chose the option 'often' or 'almost always' were added up together and reported as 'often'. The results indicated that the highest mean was reported for the statement indicating that their company runs out of inventory (mean = 3.14; SD = 0.68) indicating that the respondents felt neutral but were inclined towards agreeing with the statement. The lowest mean was reported for the statement indicating that the company sells inventory below cost price just to dispose of it (mean = 1.61; SD = 0.99) indicating that the respondents disagreed with the statement.

Table 3-10: Frequency analysis – challenges faced when managing stock

No	Statement	n	Never	Rarely	Sometimes	Often	Mean	Std. Dev
Q1.16a	Running out of inventory (stock)	72	0.00	12.50	65.28	22.22	3.14	0.68
Q1.16b	Loss of sales resulting from shortages in inventory (stock)	72	9.72	48.61	36.11	5.56	2.39	0.78
Q1.16c	Selling inventory (stock) below cost price just to dispose of it	72	63.89	20.83	6.94	8.33	1.61	0.99
Q1.16d	Theft of inventory (stock)	72	16.67	55.56	20.83	6.94	2.19	0.83
Q1.16e	Physical inventory (stock) that does not match the records	71	11.27	15.49	46.48	26.76	2.90	0.96
Q1.16f	Pilling up of inventory (stock) that is not moving	72	8.33	25.00	36.11	30.56	2.90	0.97
Q1.16g	Inability of suppliers to meet the orders made	71	5.63	33.80	40.85	19.72	2.77	0.90
Q1.16h	Unable to keep up with the demand from customers	72	12.50	65.28	13.89	8.33	2.18	0.76
Q1.16i	Increasing number of damaged inventory (stock)	72	9.72	52.78	25.00	12.50	2.43	0.90
Q1.16j	Increasing number of inventory (stock) with a passed expiry date	68	55.88	26.47	13.24	4.41	1.66	0.87
Q1.16k	Missed placed items in store that cannot be traced	71	11.27	19.72	33.80	35.21	2.94	1.03
Q1.16l	Errors due to incompetent staff	72	11.11	29.17	45.83	13.89	2.68	0.98
Q1.16n	Errors due to lack of staff (short-staffed)	71	11.27	30.99	39.44	18.31	2.72	1.04

As summarised in above table 3-10, 35.21% of the respondents indicated that they often face the challenge of misplaced items in stores that cannot be traced. 30.56% indicated that they often face the challenge of inventory piling up that is not moving, while 26.76% of the respondents indicated that they often encounter challenges of physical inventory that does not match the records. The fourth most frequent challenge encountered by the selected organisation was that they often run out of inventory (22.22%), followed by the inability of suppliers to meet the orders made (19.72%). 18.31% reported that errors arise due to lack of staff (short-staffed), while 13.89% of the respondents indicated that errors arise due to incompetent staff. Of the respondents, 12.50% reported an increasing number of damaged inventories, while 8.33% of the respondents indicated that their organisation is unable to keep up with the demand from customers. The same percentage of respondents (8.33%) indicated that their company faces the challenge of selling inventory below cost price just to dispose of it, while 6.94% of the respondents indicated that theft of inventory is also one of their challenges. The least frequent challenges encountered by the respondent's company was loss of sales resulting from shortages in inventory (5.56%), and 4.41% of the respondents indicated that their company faces the challenge of an increasing number of inventories with past expiry dates.

3.4 Results: cross tabulation

Cross-tabulation is used to determine the relationship between two categorical variables. It helps the researcher understand the correlation between the (Aprameya, 2016). The p-values are reported for completeness sake but will not be interpreted since a convenience sample instead of a random sample was used. Thus, the interpretations will be based on the effect sizes. The researcher used guideline values (not cut-offs) for the interpretation. Effect sizes:

- 0.1 practical non-significant (small);
- 0.3 practical visible significant (medium); and
- 0.5 practical significant (large).

A cross tabulation was conducted to report if there is any relationship between the following:

- Inventory management practices (Section 2: Question 1.6);
- Inventory control (Section 2: Question 1.14);
- Need for warehouse (Section 2: Question 1.15); and
- Challenges faced when managing inventory (Section 2: Question 1.16).

Table 3-11: Crosstab – relationship

Correlations		Inventory management practices	Inventory control	Need for warehouse	Challenges faced when managing inventory
Questions	Description	Section 2: Question 1.6	Section 2: Question 1.14	Section 2: Question 1.15	Section 3: Question 1.16
Sec2_1.6	Correlation Coefficient	1.000	0.241	-0.300	0.040
	Sig. (2-tailed)		0.045	0.012	0.745
	N	70	70	70	70
Sec2_1.14	Correlation Coefficient	0.241	1.000	-0.293	-0.208
	Sig. (2-tailed)	0.045		0.013	0.079
	N	70	72	72	72
Sec2_1.15	Correlation Coefficient	-0.300	-0.293	1.000	0.132
	Sig. (2-tailed)	0.012	0.013		0.268
	N	70	72	72	72
Sec3_1.16	Correlation Coefficient	0.040	-0.208	0.132	1.000
	Sig. (2-tailed)	0.745	0.079	0.268	
	N	70	72	72	72

The correlations between "Sec2_1.15" factor with the "Sec2_1.6" factor (r= -0.300) and the "Sec2_1.14" factor (r = -0.293) are medium or practically visible. All these correlations are negative, reflecting that as respondents tend to lean more towards indicating Strongly Agree with the one factor's statements they tend to Strongly Disagree on the other factor's statements.

As summarized in above table 3-11, the relationship between 'Inventory management practices (Section 2: Question 1.6)' and Inventory control (Section 2: Question 1.14)' suggests inventory control is good. This reflects that inventory management practices are in place and working. The relationship between 'Inventory management practices (Section 2: Question 1.6)' and 'Need for warehouse (Section 2: Question 1.15)' suggests that when inventory management practices are good, the need for warehousing is reduced. The relationship between 'Inventory control (Section 2: Question 1.14)' and 'Need for warehouse (Section 2: Question 1.15)' suggests that by improving inventory control, the less warehousing is needed or it could also mean that the size of warehouse required could be smaller.

3.5 Conclusion

Looking at the overall data, it can be seen that main goal of this chapter was to analyse and discuss the results of the questionnaire. The chapter presented the results on the following topics:

- Inventory management practices;
- Inventory control;
- Need for warehouse; and
- Challenges faced when managing inventory.

4 CHAPTER 4: CONCLUSIONS AND RECOMMENDATIONS

4.1 Introduction

The aim of this research study was to analyse the effect of inventory management on operational performance in a manufacturing environment. In addition, this chapter provides findings of this research summarising the contributions and at the same time presenting suggestions for further studies.

This chapter concludes and discusses the key findings of the study and evaluates the relationship between inventory management practices and operational performance, which was structured in the following four categories namely: inventory management practices, inventory control, need for warehouse and challenges faced when managing inventory. Furthermore, the chapter will provide contributions to the study, the limitations with which it was faced and will propose suggestions for further research.

The first chapter dealt with the introduction and background of the study, identifying problems of the study, defined objectives and formulated research questions to guide the investigation of the study. It also highlighted the importance of the study, scope and defined the terms used as well as presented background to the research topic. The second chapter dealt with the literature review relevant to inventory management practices, inventory control, need for warehouse and challenges faced when managing inventory. Chapter 3 presented the research design and methodology used in the study, as well as the details on the empirical study performed. The final chapter aims to draw conclusions from the results presented in Chapter 3, followed by conclusions and recommendations.

4.2 Review of literature

Over the years inventory management has often been criticized for being a cost centre. The purchasing department was spending money on inventory while stores were holding excessive stock, occupying space and funds tied up in idle assets which reduces liquidity and makes the company unable to position itself to invest in productive assets like plant and machinery (JerutoKeitany *et al*., 2014). Many manufacturing industries have recognized the importance of inventory management and the role it plays in competitive advantages. Organisations worldwide have adopted inventory management systems into their operations (Swaleh and Were, 2014). Despite the level of attention given to inventory management, manufacturing firms are still not performing as they should. Manufacturing firms are still struggling to determine the minimum inventory levels that should be kept, to keep production running and uninterrupted (Njoku and

Kalu, 2015a). Companies are faced with the challenge of finding the balance between overstocking and running out of stock (Ikon and Nwanko, 2016). Stock-outs result in complaints and criticism by customers, which in return lowers the rate of sales and decreases revenue (Nsikan *et al*., 2015). The ability to forecast accurately has also been influenced by the lack of real time inventory information because deliveries are inadequate, late and inconsistent. The performance of the firm relies on materials being available at the right time to ensure the continuation of operations (Nsikan *et al*., 2015). Manufacturing firms are finding it difficult to determine the ideal amount of inventory that should be kept. Therefore, even with the widespread use of ERP systems using MRPII logic, optimal inventory levels remain challenging as the manufacturing environment experience short-term demand changes as well as the need to source critical materials from abroad (Adeyeye *et al*., 2016). Maintaining an appropriate level of inventory remains one of the key challenges in the operational performance of a firm (Shin *et al*., 2015).

4.3 Data analysis and findings

The findings were categorised into themes that were consistent with the questionnaire and are highlighted in the sections below.

4.3.1 Respondent and business profile

This section gathered general demographic information of the participants to provide some basic background information: department of employment, level of management, years of service, level of education, and how many employees within the selected organisation.

The results were as follows:

- The detail in Chapter 3, Table 3-3 and Figure 3-2 indicated that just over one-third of the respondents were employed at operations (34.3%), the second most at quality (18.6%), third most at engineering (11.1%) and the remainder were spread between the other departments;
- The detail in Chapter 3, Table 3-4 and Figure 3-3 indicated that ten (14.1%) of the respondents were at a supervisory level of management, 23.9% of the sample was at middle management level, and 7% were at senior management level. None of the respondents indicated that they were directors (0%). 33.8% were operators, and 21.1% selected other;
- The detail in Chapter 3, Table 3-5 and Figure 3-4 indicated the number of years worked as follows: 33.3% of the respondents indicated that they had worked 0-3 years, 45.3% of

the sample had 4-10 years' experience and 16.7% had 11-15 years. Lastly 4.2% respondents indicated that they had 16-20 years' experience. The largest sample was the 4-10 years category; and

- The detail in Chapter 3, Table 3-6 and Figure 3-5 indicated that 55.6% of the respondents had a diploma certificate; 13.9% of the sample had no formal qualification but had received fabrication experience (on the job training), while 6.9% had a bachelor's degree qualification. None of the respondents indicated that they had a doctorate (0%). Only 2.8% of the respondents had a master's degree and 20.8% selected other. Therefore, most of the respondents (55.6%) had some form of formal education and were likely able to answer the questions competently.

4.3.2 Inventory management practices

This section gathered information on the process of acquiring, distributing and storing inventory within the organisation.

The detail in Chapter 3, Table 3-7 indicated that 52.11% of respondents agreed that their organisation orders inventory (stock) when they receive an enquiry from their customer. While 39.44% respondents indicated that their organisation orders most of their inventory from suppliers only within the Gauteng province. Of the respondents, 38.03% indicated that their organisation relies on common sense to determine the quantity of inventory to order. Only 30% of the respondents reported that their organisation makes use of an equation to calculate the quantity of inventory to order, while 29.58% indicated that their organisation orders a fixed quantity of inventory periodically. 21.13% of the respondents indicated that their organisation orders inventory in bulk to take advantage of trade discounts. Among the least used practices were: when the organisation's inventory (stock) reaches a certain level, they automatically place an order (19.44%); when the organisation places an order, they receive inventory (stock) without delay (16.90%); ordering inventory only when they run out of stock (12.68%); and lastly the organisation receives inventory automatically from supplier without even placing an order (2.82%). Looking at the mean and standard deviation in Table 3-7, most of the respondents felt neutral but were inclined towards agreeing with the statement, excluding Q1.6 F where the respondents disagreed with the statement.

From the results identified in the above table; it can be argued that the organisation uses a make-to-order (MTO) model for production. This means that production does not start until a customer places an order. This strategy reduces an organisations exposure to financial risk, but also extends delivery date to customers as a result of long lead times from suppliers and eventually creates backlogs (Fattahi and Khodadad, 2015:2).

Furthermore, it is also likely that the organisation uses a min-max inventory approach, which consists of two parts, namely; a maximum amount of inventory and a minimum amount. This means when stock reaches a critical level, an alert will occur to replenish the stock, which implies that the replenishment of certain items will be realised at different stages, ensuring 100% stock availability and reducing the possibility of stock-outs. However, it is not possible to order more than the maximum amount (Apsalons and Gromov, 2017:80).

4.3.3 Inventory control

The detail in Chapter 3, Table 3-8 indicated that 81.94% of the respondents agreed that their organisation's warehouse staff verify delivery, receipt and storage of stock. Of the respondents, 76.06% indicated that they use computers to record inventory received, while 69.44% indicated that the disposal of inventory must be authorised by senior staff. The same percentage (69.44%) of respondents confirmed that they have clear procedures followed by staff when it involves receiving and issuing stock from their warehouse. Of the respondents, 63.89% confirmed that access is restricted to the organisation's warehouse to authorized staff only. Of the respondents, 51.39% indicated that the organisation's staff can determine inventory balances at any time. Only 47.22% of the respondents indicated that if an anomaly arises when inventory is delivered it gets reported to senior personnel. Likewise, only 41.67% indicated that purchase order copies are sent to the storekeeper to verify deliveries made. Of the respondents, only 30.99% indicated that their organisation makes use of a barcoding system to monitor movement of inventory in the warehouse. The lowest percentage (14.08%) of respondents indicated that their warehouse staff has access to accounting records. However, it is important to note that 50.7% of the respondents indicated that they were uncertain.

4.3.4 Need for warehouse

The detail in Chapter 3, Table 3-9 indicated that 44.29% of the respondents agreed that their company is very small, so they store all their inventory (stock) within their premises. This could also mean that the company's premises are large enough to keep all their inventory on site. Of the respondents, 23.61% indicated that their company does not pile up slow moving stock which requires a warehouse. Only 9.86% of the respondents indicated that their company deals in perishable goods that cannot be stored in a warehouse, while 8.33% of the respondents indicated that their company needs a warehouse but cannot afford one. The same percentage (8.33%) of the respondents indicated that their company does not need a warehouse because they only order an item when a customer places an order. The lowest percentage (5.56%) of respondents indicated that their company does not need a warehouse because they buy from suppliers and deliver straight to their customers.

4.3.5 Challenges faced when managing stock

The detail in Chapter 3, Table 3-10 indicated that respondents often face the challenge of misplaced items in stores that cannot be traced. 30.56% indicated that they often face the challenge of inventory piling up that is not moving, while 26.76% of the respondents indicated that they often encounter challenges of physical inventory that does not match the records. The fourth most frequent challenge encountered by the selected organisation was that they often run out of inventory (22.22%), followed by the inability of suppliers to meet the orders made (19.72%). 18.31% reported that errors arise due to lack of staff (short-staffed), while 13.89% of the respondents indicated that errors arise due to incompetent staff. Of the respondents, 12.50% reported an increasing number of damaged inventories, while 8.33% of the respondents indicated that their organisation is unable to keep up with the demand from customers. The same percentage of respondents (8.33%) indicated that their company faces the challenge of selling inventory below cost price just to dispose of it, while 6.94% of the respondents indicated that theft of inventory is also one of their challenges. The least frequent challenges encountered by the respondent's company was loss of sales resulting from shortages in inventory (5.56%), and 4.41% of the respondents indicated that their company faces the challenge of an increasing number of inventories with past expiry dates.

4.3.6 Summary of data analysis and findings

The detail in Chapter 3, Table 3-11 indicates the relationship between 'Inventory management practices (Section 2: Question 1.6)' and Inventory control (Section 2: Question 1.14)' suggests inventory control is good. This reflects that inventory management practices are in place and working. The relationship between 'Inventory management practices (Section 2: Question 1.6)' and 'Need for warehouse (Section 2: Question 1.15)' suggests that when inventory management practices are good, the need for warehousing is reduced. The relationship between 'Inventory control (Section 2: Question 1.14)' and 'Need for warehouse (Section 2: Question 1.15)' suggests that by improving inventory control, the less warehousing is needed or it could also mean that the size of warehouse required could be smaller.

Furthermore, from the detail above the following was identified:

- The lack of transparency around inventory management practices: the cost inventory incurs is heavily influenced by the absence of clear and visible processes and activities;
- Inventory management is seen as a support function for manufacturing, while it should be a core strategic focus;
- Organisations do not invest adequate resources to understand the challenges faced to manage inventory properly;
- Rate of technology adoption is lagging critically behind world trends, which indirectly affects the adoption of advanced inventory management practices; and
- Performance of inventory management is stagnant, lagging adaptability and customisation of processes due to technology being behind world trends.

4.4 Contribution of the study

The study provides several useful contributions to the literature on the effectiveness of inventory management practices and the control of inventory. Furthermore, it fills the gap in knowledge on inventory management practices and operational performance in a manufacturing environment in South Africa.

Most prior studies have covered larger entities, and few have focused on smaller organisations. Moreover, the study covered other existing knowledge gaps and has set the stage for other researches to build on this research in the area of inventory management.

Finally, this work has contributed to the study of inventory management by reviewing literature inventory management practices such as inventory control, types of inventory, advantages and disadvantages of keeping inventory, techniques for controlling inventory and possible conflicting objectives of inventory controls, as well as operational performance and the relationship between inventory management practices and operational performance.

4.5 Achievement of the study objectives: evaluation

4.5.1 Primary and secondary objectives

The primary objective of this study was to investigate the effect of inventory management and the possible impact it has on the performance of operations.

The primary objective was met through the literature review (Chapter 2) by providing an overview of the relationship between inventory management and operational performance, which confirmed that there is a positive and strong relationship between inventory management and operational performance. In addition, the level of investment in inventory management will assist organisations in maintaining optimal levels of inventory as well as assist with estimating, controlling and tracking of inventory to ensure a positive influence on operational performance.

The empirical study (Chapter 3) assessed the different processes involved in controlling inventory and the result was discussed in detail.

The secondary objectives were addressed as follows:

- Where the gap of inventory control and record accuracy lies - in the lack of transparency of inventory management practices as well as the rate of technology adoption is lagging, which is critically behind world trends (see Table 3-7, Q1.14f and Q1.14g);
- The effects of stockouts on production - proper material codification and storage procedures correlate positively and significantly with operational performance (see Table 3-9, Q1.16a and Q1.16k);
- The implication of stockouts on purchasing behaviour – reduces the chances of receiving the advantage of trade discounts and planning of projects and/or future projects is difficult as usage of certain items has no real time data (see Table 3-6, Q1.6a, Q1.6d and Q1.6g); and
- Strategies to mitigate the adverse effects of stockouts – achieved throughout the whole research paper as various gaps and opportunities for improvement were highlighted.

4.6 Limitations of the study

The study took place at a critical time in the nation's economic history, which influenced both individuals and organisation. The main influencer was the COVID-19 pandemic, that impacted the global economy, global supply chains, and nations. The COVID-19 pandemic also affected the availability of participating individuals as the country went into lockdown to protect the health of the South African population, the following challenges were identified:

- Individuals were not at work, being located in different geographical areas;
- Fear of being in contact with other people (including the researcher);
- Some individuals did not have excess to a computer; and
- Lost questionnaires.

Moreover, the study was carried out using a sample of individuals from one single company, with a low number of participants, which limits the generalisations that could be made from the result. The name of the company could also not be published.

In addition, the selected organisation, ABC GROUP (PTY) LTD (ABC GROUP), corporate family started selling their businesses which consisted of five key markets. Formed out of the gigantic Dorbyl in the early 2000s, ABC GROUP was a heavy engineering player focused on five key markets: Rail, defence, mining, energy and marine. ABC GROUP was a global force, with a large portion of sales generated for export. Additionally, the group has been an integral participant in South Africa's infrastructure development for decades. After selling most of the companies within ABC GROUP, '123 Africa' acquired the rail facility in 2018 and transferred some of the staff to the new company. The initial target population/participants aimed to incorporate at least three of the five companies of the former ABC GROUP and as a result forms part of the limitations to this study with only limited participants taking part in the survey. As a result of these challenges, the participation in the research was affected as some employees refused to take part in the research study.

With '123 Africa' as the new organisation, the structure of the organisation changed and so did management. Newly employed management and directors of the selected manufacturing organisation felt reluctant to give approval for the questionnaire. This forced the researcher to schedule several meetings with the newly employed management before permission was finally granted.

This study recognizes that there are several variables, apart from the variables identified in this study that could potentially contribute to operational performance. The researcher is also mindful of the fact that there are other practices of inventory management performance beyond the variables identified in this study. Furthermore, some variables in this study with regards to inventory management practices and operational performance were based on assumptions that they are in constant design with the view to achieve the stated objectives of this research work.

4.7 Recommendations

Based on the findings of the study, the following recommendations were made:

- Upgrading of inventory control technology such as barcoding system and RFID technology to track the movement of inventory;
- Dedicated strategic focus to enhance the digital technology platform, in order to adapt to changing business ecosystems; and

- Training of staff to align their internal inventory control policies to accommodate new strategies such as opportunity, transaction, and location-based inventory cycle counting.

4.8 Suggestions for further research

Due to the limitations identified, the suggestions for future research are based on the inherent limitations of this study.

Firstly, the study should take place at a different time period (i.e., after the COVID-19 pandemic) as the COVID-19 pandemic had a huge impact on the economy, availability of certain materials and products, as well as the general morale of individuals and/or organisations.

Secondly, further research should make use of a larger group of manufacturing companies, this will help establish if this research could be replicated in different sectors.

Thirdly, future research should consider conducting the same research in another province to compare results over a wider geographical area.

Lastly, the current research was based on a survey instrument and future studies should consider additional oral interviews to generate richer and deeper insight into the topic.

4.9 Conclusion

Inventory management is not just a support function for manufacturing and should form part of the core strategic focus. Inventory management and the control thereof is crucial to a manufacturing environment as it was discovered that inventory management is positively related to a company's operational performance. Moreover, it was highlighted that automated inventory management techniques are beneficial to manufacturing organisations and companies should invest more resources to keep technology up to date and relevant. Policies and procedures should constantly be monitored and evaluated to assist in identifying and closing gaps in time.

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ANNEXURE A: INFORMED CONSENT FORM

TMH AFRICA

Physical Address: Victor Street • Industrial Sites • Boksburg East, 1460 • South Africa
Tel: +27 11 914 1400 • Fax: +27 11 914 2318 • **www.tmhafrica.co.za**
Postal Address: PO Box 229 • Boksburg, 1460 • South Africa
Reg: 2017/660393/07 • VAT: 4530283367

To whom it may concern

This communique serves to give permission to Mr. JP Lessing, a MBA student of the North West University Business School, to use TMH Africa to gather information regarding his script for the degree.

His study is about the effect of inventory management in respect of the manufacturing environment in South Africa.

Kind Regards,

Name: Z. NTSHIZA

Postion: FINANCIAL DIRECTOR
09/10/2019

Ethics informed consent form

MBA STUDY: Analysing the effect of inventory management on operational performance in a manufacturing environment.

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FIELD OF STUDY: MBA

NORTH-WEST UNIVERSITY

RESEARCHER: Jacobus Paulus Lessing

SOUTH-AFRICA

CELL: 082 850 1223

Email: jacqueslessing01@gmail.com

Dear Volunteer

This Informed Consent Statement serves to confirm the following information as it relates to the MBA mini dissertation on <u>analysing the effect of inventory management on operational performance in a manufacturing environment.</u>

.

1. The sole purpose of this study is to obtain information from staff employed and operating in various SA industries to analyse the effect of inventory management on operational performance in a manufacturing environment.
2. The procedure to be followed is a quantitative research design in the form survey questions.
3. This completion of a questionnaire takes place voluntarily and at any time you can withdraw.
4. The confidentiality of the questionnaire data is guaranteed — fictitious names can be utilised when utilising the data obtained from the questionnaires.
5. Any confidential information that prohibits the researcher to publish it in the final dissertation should be communicated.
6. A summarised copy of the final dissertation will be made available to the organisation’s involved only upon request.

7. The data gathered from the questionnaires will only be for research purposes as this is an academic study.

We do ask you for some demographic information. This is to profile the different demographic groups of the respondents, and not for comparative purposes. Also, no individual respondent can and will be identified in this profiling exercise.

I hereby declare that I have read and understand the contents of the Informed Consent Statement, and give my full consent by providing a tick in the box below to **JP Lessing** to progress with the survey questionnaires on ________________________ (date) and use the information provided by myself to him in his MBA dissertation.

Consent "tick box"

ANNEXURE B: DATA COLLECTION INSTRUMENTS

Inventory Management Questionnaire

Appendix B: Questionnaire

Section 1: RESPONDENT AND BUSINESS PROFILE

(Please mark “X” in the appropriate box)

1.1 Which of the following best describe your department of employment?

a) Operation	
b) Engineering	
c) Quality	
d) Marketing and Sales	
e) Fabrication	
f) Maintenance	
g) Planning	
h) Stores and warehousing	
i) Procurement	
j) Finance	
k) other (please specify)	

1.2 Level of Management?

a) Supervisor	b) Middle Management	c) Senior Management	d) Director	e) Operator	f) Other

If you choose “other”, specify briefly. ___________________________________

1.3 How many years have you worked for this specific company?

a) 0-3	b) 4-10	c) 11-15	d) 16-20	e) 20 years+

1.4 What is your highest level of education?

a) Diploma	
b) Fabrication	
c) Bachelor’s degree	
d) Master’s degree	
e) Doctorate	
f) other (please specify)	

1.5 How many employees in total working for the company/organisation?

Less than 5	Between 5-100	Between 101-200	Between 201-500	More than 500

Section 2: INVENTORY (STOCK) MANAGEMENT PRACTICES

(Please mark "X" in the appropriate box)

1.6	To what extent do you agree with the following statements about how your business orders inventory (stock)? (Please mark "X" in the appropriate box) Please use the following scale to answer the next questions: SD= Strongly Disagree, D = Disagree, N= Neither agree nor disagree, A= Agree, SA= Strongly Agree	Don't know	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a	The company relies on common sense to determine the quantity of inventory (stock) to order	DK	SD	D	N	A	SA
b	The company uses an equation to calculate the quantity of inventory (stock) to order	DK	SD	D	N	A	SA
c	The company orders a fixed quantity of inventory (stock) periodically	DK	SD	D	N	A	SA
d	The company orders inventory (stock) in bulk to take advantage of trade discounts	DK	SD	D	N	A	SA
e	The company orders inventory (stock) when we receive an enquiry from our customer	DK	SD	D	N	A	SA
f	The company receives our inventory (stock) automatically from our suppliers without even placing an order	DK	SD	D	N	A	SA
g	The company orders only when we run out of stock	DK	SD	D	N	A	SA
h	When the company's inventory (stock) reaches a certain level, they automatically place an order	DK	SD	D	N	A	SA
i	When the company places an order, they receive inventory (stock) without delay	DK	SD	D	N	A	SA
j	The company orders most of their inventory (stock) from suppliers only within Gauteng province	DK	SD	D	N	A	SA

1.8 Does your company prepare inventory (stock) budgets in your business?

- Yes [ ] No [ ]

1.9 Does your company compare inventory (stock) ordered to the budgets regularly in your business?

- Yes [ ] No [ ]

1.10 Does your company update their inventory (stock) budgets regularly in your business?

- Yes [ ] No [ ]

1.11 Does your company conduct stocktaking in your business?

- Yes [ ] No [ ]

1.12 If yes, to question 1.16, how often does your business conduct stocktaking?
(Please mark "X" in the appropriate box)

a) Daily	
b) Weekly	
c) Monthly	
d) Every six months	
e) Annually	
f) other (please specify)	

1.13 Does your company track the movement of inventory (stock) from the time an order is placed to the time stock is received?
Yes [ ] No [ ]
1.14 Does your company have dedicated staff that manage the warehouse (stores)?
Yes [ ] No [ ]

1.15	To what extent do you agree with the following statements about inventory (stock) control by your company's staff in the warehouse (stores)? (Please mark "X" in the appropriate box) Please use the following scale to answer the next questions: SD= Strongly Disagree, D = Disagree, N= Neither agree nor disagree, A= Agree, SA= Strongly Agree	Don't know	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a	The company's warehouse staff verify delivery, receipt and storage of stock	DK	SD	D	N	A	SA

b	The company's warehouse staff have access to our accounting records	DK	SD	D	N	A	SA
c	Does your company have clear procedures followed by staff when receiving and issuing stock from our warehouse	DK	SD	D	N	A	SA
d	Access to the company's warehouse is restricted to authorized staff only	DK	SD	D	N	A	SA
e	The company's staff use computers to record inventory (stock) received	DK	SD	D	N	A	SA
f	The company's staff can determine inventory (stock) balance at any time	DK	SD	D	N	A	SA
g	The company's staff can determine inventory (stock) balance at any time	DK	SD	D	N	A	SA
h	The company's staff use a barcoding system to monitor movement of inventory (stock) in the warehouse	DK	SD	D	N	A	SA
i	Disposal of inventory (stock) must be authorized by senior staff	DK	SD	D	N	A	SA
j	Purchase order copies are sent to the storekeeper to verify delivery made	DK	SD	D	N	A	SA
k	Anomaly in inventory (stock) delivered is reported to senior personnel	DK	SD	D	N	A	SA

1.13	To what extent do you agree with the following statements about the need for a warehouse in your company? (Please mark "X" in the appropriate box) Please use the following scale to answer the next questions: SD= Strongly Disagree, D = Disagree, N= Neither agree nor disagree, A= Agree, SA= Strongly Agree	Don't know	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a	The company does not need a warehouse because they buy from suppliers and deliver straight to customers	DK	SD	D	N	A	SA
b	The company does not need a warehouse because they only order an item when a customer order from them	DK	SD	D	N	A	SA

c	The company is very small, so they store all their inventory (stock) within their premises	DK	SD	D	N	A	SA
d	The company does not pile up slow moving stock which requires a warehouse	DK	SD	D	N	A	SA
e	The company deals in perishable goods that cannot be stored in warehouse	DK	SD	D	N	A	SA
f	The company need a warehouse but cannot afford one	DK	SD	D	N	A	SA

Section 3: CHALLENGES FACED WHEN MANAGING STOCK
(Please mark "X" in the appropriate box)

1.14	How often do you experience the following challenges in your business? (Please mark "X" in the appropriate box) Please use the following scale to answer the next questions: N= Never, R = Rarely, S= Sometimes, O= Often, AA= Almost always	Never	Rarely	Sometimes	Often	Almost always
a	Running out of inventory (stock)	N	R	S	O	AA
b	Loss of sales resulting from shortages in inventory (stock)	N	R	S	O	AA
c	Selling inventory (stock) below cost price just to dispose of it	N	R	S	O	AA
d	Theft of inventory (stock)	N	R	S	O	AA
e	Physical inventory (stock) that does not match the records	N	R	S	O	AA
f	Pilling up of inventory (stock) that is not moving	N	R	S	O	AA
g	Inability of suppliers to meet the orders made	N	R	S	O	AA
h	Unable to keep up with the demand from customers	N	R	S	O	AA

i	Increasing number of damaged inventory (stock)	N	R	S	O	AA
j	Increasing number of inventory (stock) with a passed expiry date	N	R	S	O	AA
k	Missed placed items in store that cannot be traced	N	R	S	O	AA
l	Errors due to incompetent staff	N	R	S	O	AA
n	Errors due to lack of staff (short-staffed)	N	R	S	O	AA

Section 4: CRISIS MANAGEMENT PRACTICES

(Please mark "X" in the appropriate box and elaborate on your answer where it is requested to do so.)

1.15 Does your organisation have crisis management teams to manage short-term liquidity impacts and initiate appropriate countermeasures?

- Yes [ ] No [ ]

1.16 Has your organisation defined supply chain and production risks that crises might pose and what do you think they should do to mitigate those risks?)

- Yes [ ] No [ ]
- (Please elaborate)

1.17 When a crisis has significant financial impact, how can your organisation adapt their business model to reduce costs, both in the short and long term?

- (Please elaborate)

